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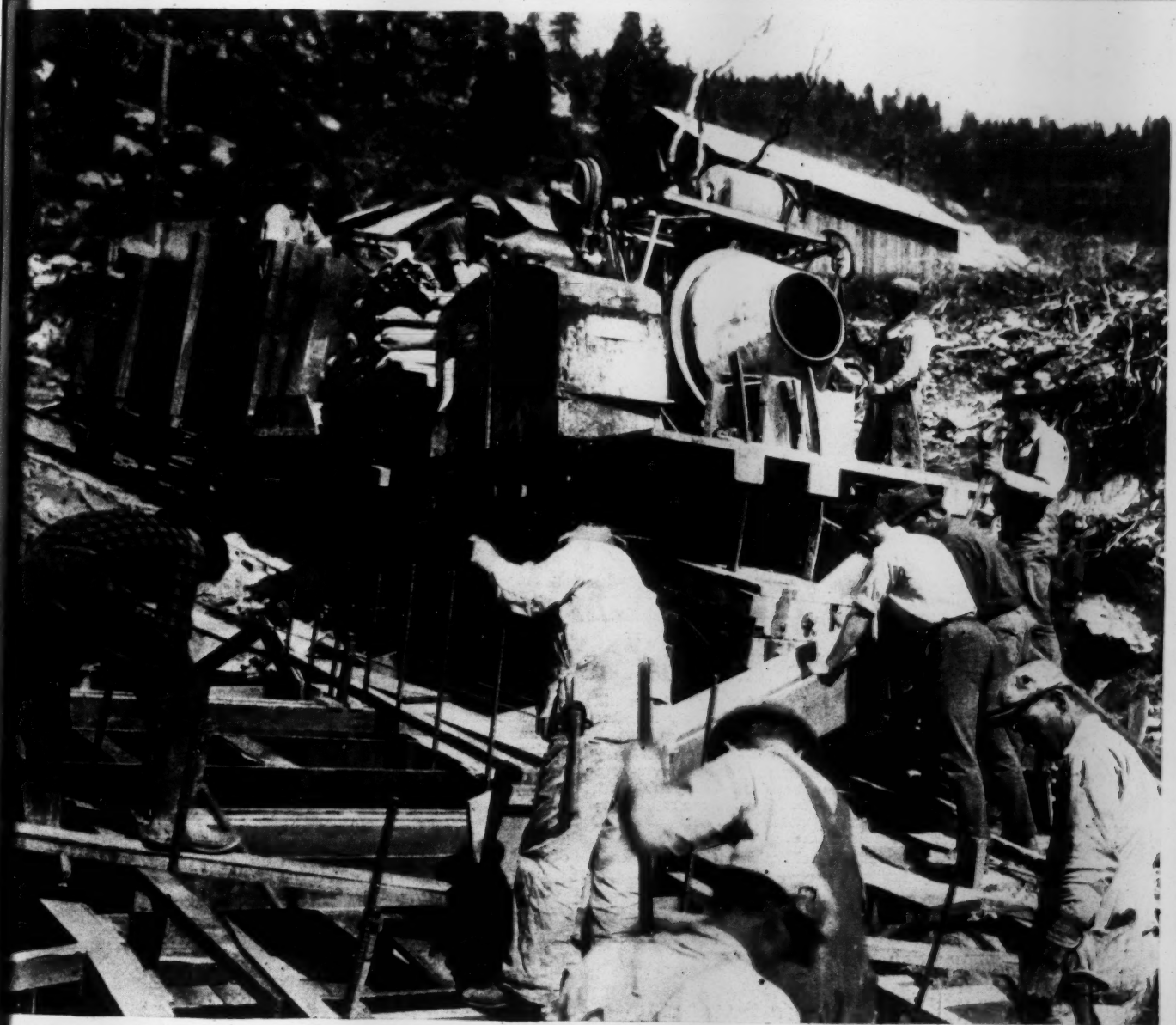

Concreting plant for penstock anchors mounted on incline railway

Behavior of Flexible Reinforced-Concrete Mattresses as Bank Protection on Deep Rivers—Effective Form Handling Cableway at Philadelphia Stadium—Welded Steel Structural Members and Joints Tested at Pittsburgh—Schenectady Markets Its Sewage Sludge—A Cane Sugar Mill and Plantation in Florida, *another article in the industrial building series*

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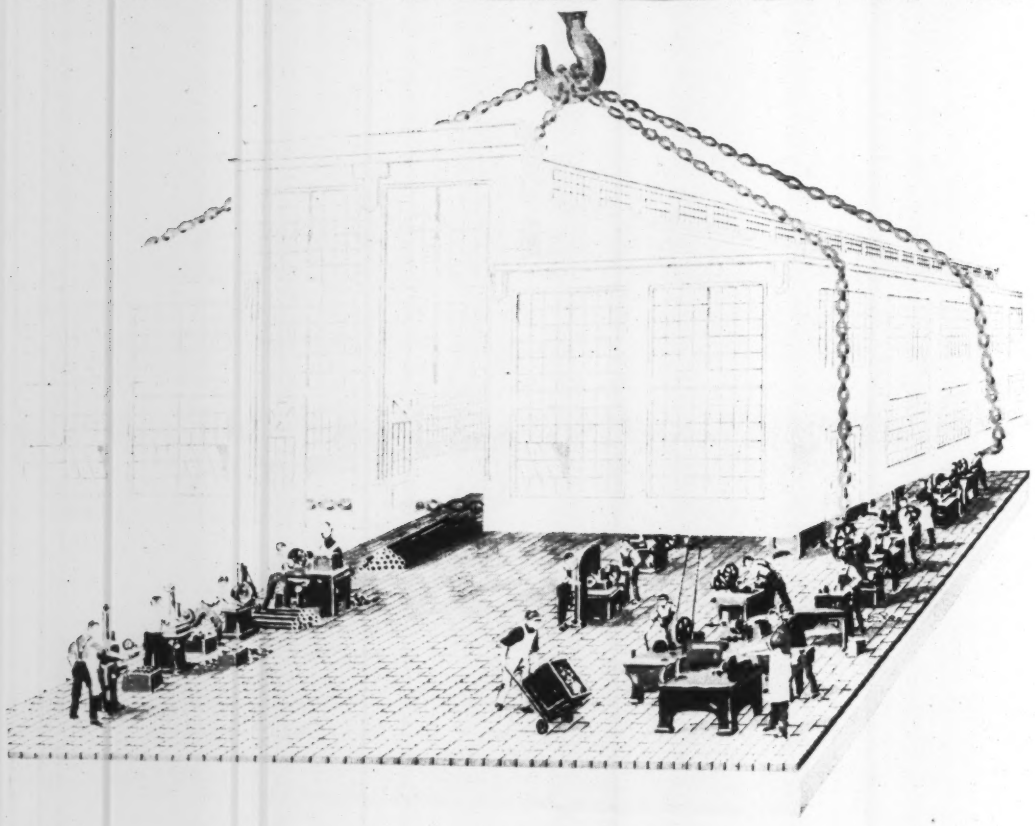

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

McGraw-Hill Publishing Co., Inc.
JAMES H. McGRAW, *President*
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FRANK C. WIGHT
Editor

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Proportionate Sin

CORPORATE members of the American Society of Civil Engineers have received official notice of the expulsion from the society of two of its members. Strict adherence to the constitutional provision for this action has been observed; charges were brought, the accused were heard, the board of directors considered the charges and acted thereon and finally the corporate members were formally notified that these two men had been expelled from membership, "for cause." As the constitution is written this is proper procedure, but this first expulsion under the current constitutional provision brings up some doubts as to the adequacy of the method. Punishment for misdoing is intended not only to chastise the wrongdoer but also to warn the potential wrongdoer. If a member of the American Society of Civil Engineers so conducts himself that the elected board, after consideration of his defense, considers him unworthy of membership, his removal, especially when his fellow members are specifically advised of it, is a proper punishment for his misdoing but when his fellows are not advised of the cause of the expulsion the force of the expulsion is lost, so far as ethical principles are concerned. Was he expelled for lax personal morals, or for violation of the criminal code, or did he merely fail to observe the letter or spirit of the society's code of ethics? These are questions the members may well ask. How far does a man have to go before he is expelled from the American Society of Civil Engineers? We ask that seriously, not because we question the board's action in this particular case, but because now that the board has the courage, which other boards have lacked, to take punitive action, it seems a pity that the ten thousand or more members who are thus being protected should not know what are the standards that are violated.

Perpetual Labor

A RECENT transcontinental railroad journey made vivid once more to one observer the tremendous labor that track maintenance involves. Of course every engineer knows what section-hand work means and any one can glean from reports the cost to any railroad of keeping its track in safe and comfortable condition, but really to visualize this unceasing effort one should ride the observation car from ocean to ocean. Every mile or so one passes them, these section gangs, in the lonely Sierras or Rockies the cheerful Chinaman or stolid Indian, transformed plainsmen in the Middle Western slopes and hunkie or smiling negro as one approaches the Atlantic, digging under tracks, tightening bolts, straightening rails, forever making smooth the way of the carefree traveler. Elementary engineering, perhaps, but constant toil, and one of the fundamental contributions the engineer makes to a more pleasant world. And like so many of the engineer's contributions it is accepted by the world without thought or thanks. There is nothing spectacular in keeping a railway track secure but it is one of those major drudgeries that are necessary to existence in a modern world. No wonder that so many of our railroad engineers ponder and dream over the possibilities of some kind of track that will have permanence and a freedom from the constant maintenance that our hundred years of railroading has not yet been able to avoid.

Archaic Charges

A LARGE part of the water supplied New York City for strictly domestic consumption is charged for on a combined frontage and height basis. This is archaic. Milk, coffee, tea, sugar, potatoes, flour and other table and household supplies are sold according to the volume delivered. Why not water? Because the frontage and height basis was adopted before there were water meters is no reason for continuing it now that there are plenty of reliable meters to choose from and when universal metering has been in use for years in many cities with notable reduction of water waste and with an equitable distribution of the cost of water service according to the quantity consumed and wasted. Just as New York City is getting toward the end of spending some $200,000,000 for its Catskill water supply, it is faced with the necessity of a huge additional outlay as soon as it can get through with the necessary preliminaries. Universal metering would postpone some at least of the expenditures and would be a continuing benefit.

Sludge Marketing

THE growing sales of sludge produced at the sewage-works of Schenectady, N. Y., are due to good marketing work. Armed with authoritative analytical data the works' superintendent enlisted the co-operation of the local farmers and market gardeners' associations and of the press. Meetings were addressed and farms visited to spread the message. Attractive samples of the dried sludge were exhibited. Farmers were induced to visit the sewage-works and to try the sludge. Three seasons of growing sales, this year with a heavy advance in price, give promise that at last one American city will soon be selling all the sludge it produces. Measured in dollars, the returns are small; but farmers have taken enough sludge directly from the beds to save the city several times as much in labor charges for cleaning beds as the city has received in cash. Presumably, this labor-saving is too irregular to be wholly advantageous and even if it could be counted on any city would prob-

ably find it better in the long run to clean its own sludge-drying beds in its own way and time, emptying its dump cars into the farmers' wagons when the latter are at hand, as has been done sometimes in the past, and dumping the remainder onto a concrete platform, tentatively projected, instead of on to the ground. At Baltimore, Md., as reported in this journal, July 3, 1924, p. 13, the city loads farmers wagons free of charge and, at latest accounts, gives them the sludge for its removal. More than a half century of attempts to sell sewage sludge, in England and America, have resulted in little and that confined chiefly to British cities. Perhaps the time is ripe for a change. If so, good marketing methods will be a main element of success.

Engineer Municipal Rulers

THE District of Columbia is governed, and governed well so far as the executive is concerned, by three commissioners, appointed by the President. One of them by law has to be a member of the Corps of Engineers of the United States Army, and to him is entrusted what is in effect the office of city engineer. The other two have been everything, from local merchant to newspaper man. President Coolidge last week, however, violated precedent by appointing to one of these two positions an engineer. Mr. Dougherty, as the news item on another page tells, has had large experience in mechanical and electrical engineering work. Colonel Bell, the engineer commissioner, is well versed in the civil and military engineering field, so that between them they cover practically the whole range of engineering, as well as constituting a majority of the governing body of the nation's capital city. Washington is the trial balloon of much national legislation, the "dog" on which many novelties are tried out. For a while, then, we will have an opportunity to see how engineers can govern a city and the whole country may be able to draw a lesson therefrom. Mr. Dougherty and Colonel Bell are carrying a considerable responsibility to their profession.

Care Repaid in Concreting

MUCH progress is being made in the making and placing of concrete. It is encouraging to find that slowly it is being impressed on the so-called "practical" concrete man that perhaps his thirty years of practice has not all been devoted to the best possible way of putting cement and stone and water together to make a durable material and that a few despised "theorists" have been learning in five years what he has not been able to learn in many times that. But in spite of this developing sense of obligation on the part of the mixer and placer of concrete there still remains an unwarranted amount of astonishingly poor concrete being placed on major jobs. Two particularly came to recent notice. Each of these was built by responsible contractors under responsible engineering direction; each involved a large amount of concrete many square yards of which were exposed long before the job was completed. And in each case the finished concrete was deplorable, so bad in one structure that its opening to load has been delayed though the work is finished, so bad in the other that the complete surface had to be patched up with a cement gun to conceal the honeycombing that must go much deeper than the surface that is now concealed. The curious point in each of these cases is why the engineer, noting the unsatisfactory concrete of the early work, let the contractor continue the same methods, or why either engineer or contractor could not see that the kind of concrete they were getting was unsatisfactory because of the methods being used. There seems to be too often some kind of a blind confidence that concrete will take care of itself in time, and an unbelievable denseness on the part of practical men as to the obvious relations between cause and effect. Nothing the engineer deals with so repays study and care as concrete, but it seems to be a hard job to persuade a great number of those who use it of that fact.

Hard Questions

THE recent popular defeat at Middletown, N. Y., of a bond issue for sewage-works virtually if not actually demanded by the New York State Department of Health raises a number of questions of interest in every state and city in which the legislature has vested control over sewerage and sewage disposal in its state health department. These questions center in the legal possibility of enforcement of such delegated powers; in the practicability of enforcement as a matter of every day administration expediency; the extent to which such powers may be weakened if not virtually nullified in case the orders of a state department of health cannot be executed by the administrative agents of the city without a referendum vote, which carries with it approval not only of a bond issue but also of a particular plan for spending the money. In the case in point, the questions raised are further complicated by the fact that although the sewage-works bonds were defeated by a vote of 314 against, to 134 for, the 471 who voted were only a small fraction of the "nearly 3,500 taxpayers." Notable also is the fact that this was the third time in three years that the taxpayers have voted down public improvements. Unfortunately, general apathy on vital municipal problems is not uncommon in American cities. What can be done about it?

In 1914 the New York State Health Department gave a permit for extensive additional sewers, says *Health News*, the official organ of the department, on condition that plans for a disposal system be submitted to it and the mayor promised that construction of the sewage-works would not be delayed. The sewers were extended and plans for disposal works were submitted to and approved by the department, but the city did no more. Ten years later, on further complaint from the town of Wawayanda, through which flows Monhagen Brook, the small stream which has received the untreated sewage of Middletown for thirty years, the state commissioner of health cited the city authorities to appear Jan. 29, 1925, and show cause why discharge of crude sewage into the brook should not be stopped. The city officials promised action, and again submitted plans for sewage treatment. These plans were approved by the state health department, on condition that construction of the works be started by Sept. 1, 1926, and completed by Jan. 1, 1928. Soon after the recent disapproval of the proposed bond issue the mayor is reported to have said that he still favored the erection of sewage-works but to have added, as though washing his hands of the affair

"I shall await with interest any action taken by the State Department of Health in the matter."

What can any state department of health do in such a case? The answer depends, primarily, on statutory provisions, but other factors may demand consideration, especially when city authorities cannot build sewage-works without a favorable vote on the project by the electorate.

The very essence of a popular referendum on a bond issue is to give the electorate a chance to disapprove it. This they may do because they object to increasing the existing debt, or to the object of the debt, or if not to the object then to the method of achieving it or to distrust of the existing city administration. State administrative departments as a matter of expediency, if for no better reason, are bound to consider these grounds for popular disapproval of sewage bond issues. Most courts, too, would take cognizance of some if not all of them, at least to the extent of giving the local authorities a chance to submit a modified plan to popular vote.

Broadly viewed, the defeat of sewage-works bonds at Middletown is less serious than the small percentage of those entitled to vote who took the trouble to do so. Regard for their neighbors on the stream below, for the promises made by their own city authorities to the State Department of Health, and fear of the powers of the department, all combined, brought out only 134 votes for the bonds, while in disregard for all these things only 314 voted against the bonds. Such apathy is a sad commentary on representative government; all the sadder because while this may be an extreme case apathy at municipal elections is not uncommon. What can be done about either this general apathy or such indifference to the orders of a State Department of Health as has been displayed for ten years past at Middletown?

Once More The Navy Exonerates Itself

SO FAR as the Navy Department is concerned the explosion of the Lake Denmark Arsenal is a thing of the past, an unfortunate but unavoidable incident. The Navy Court having determined this, the Navy Department has set about making its plans for new and safer arsenals. That is as it should be from the point of view of the Navy Department. But for a lot of people who lost family or home, or who went through the hell at Lake Denmark—both inside and outside of the Army and Navy—the matter is still a very live issue. For their benefit as well as those who may be threatened with a similar menace from other arsenals elsewhere in the country there are a few questions which should be put to the Navy Department now before changes in personnel make it more difficult to answer them.

In commenting upon the accident before the Navy Court of Inquiry was set up we purposely refrained from raising these questions in the hope that some member of the court would bring them up. But now that the investigation is over and the report is written these points which seem to us to be of major importance do not appear to have been touched upon except lightly, as if of minor importance. The court found no one, neither individual nor government department, responsible for the vast destruction of life and property. The court found the accident was caused by a force beyond the control of man; everything humanly possible had been done to protect the arsenal from lightning, and despite these efforts it was set off by a stroke of lightning.

But when the Navy Court had made its determination as to the cause and methods of protecting against the ill-effects of lightning it only had begun rather than completed a proper investigation of the Lake Denmark explosion. Granting that man cannot control lightning or direct it into safe paths, there still remain these points to be determined upon:

Who was responsible for such a vast and, had the United States been subject to New Jersey state law, illegal concentration of explosives in a square mile of territory?

Who was responsible for having this explosive material housed in buildings with combustible framing and fittings?

Who was responsible for explosives being carelessly housed with projectiles and depth bombs instead of being segregated to reduce the risk of all being set off in case part was set off?

And who was responsible for there being neither barricades or adequate spacing between buildings to stop the spread of destruction?

In answering these questions the Navy should not be permitted to claim that what it says now is in the light of knowledge gained in the Lake Denmark explosion, for knowledge on these points is of long standing. The Navy may have gained added knowledge in these matters but no *new* knowledge. The engineering world knew that the storing of explosives in non-firesafe buildings was increasing the risk. The Navy surely should have known it also. It knew, or ought to have known, that barricades or wider spacing between the buildings would have reduced the risk. It knew years ago just as its Court of Inquiry now reports that the various classes of explosive material within the arsenal should have been segregated, and it must have known that to pile up a lot of old and partly useless excess material left over from war days along with its necessary supplies for the part of the Navy operating in the New York district was inviting trouble. These actions cannot be disposed of in the convenient classification of "Acts of God." They are the acts of some person or persons in the Navy Department, not done maliciously but with that sort of stupidity which any bureaucratic organization develops.

Proper facts as to such questions apparently cannot be expected from the Navy investigating itself. When a naval officer runs his ship aground, or maneuvers his vessel into difficulty in battle, even when the department orders a dirigible into areas subject to storms specifically declared by the ship's designers to be dangerous to its integrity—these may well be the subject of an inside investigation because presumably they concern only the Navy and because expert knowledge outside the Navy is scarce. But when the vagaries of the departmental mind not only risk millions of the country's money but endanger the lives and property of helpless citizens by violating known principles of explosives storage, some investigating agency less prone to gloss over mistakes is demanded. Naval courts of inquiry are becoming suspiciously careful of criticism of errors that the Navy makes.

Behavior of Flexible Reinforced-Concrete Mattresses as Bank Protection on Deep Rivers

Satisfactory Results Obtained in River Work in Japan—Method of Laying Mattresses and Fascines in Deep Water—Experience with Steel Wire for Under-water Work

By B. Okazaki
Engineer-in-chief, Upper Liao River Conservancy, Newchwang, China; Formerly, chief engineer, Ishikari River Improvement Works, Japan

In this article the author explains the result of long-time tests of the flexible concrete mattress tried under his charge on a Japanese river with particular regard to the costs of construction as well as repair, as observed during the past thirteen years.

This study is a sequel to other articles on the same subject, by the same author, and is intended to bring the information given in the earlier articles up to date. The previous articles were published in Engineering News May 16, 1912, p. 922; March 13, 1913, p. 512; June 25, 1914, p. 1404; June 8, 1916, p. 1080, and Engineering News-Record, Oct. 17, 1918, p. 713.—Editor.

SINCE the inauguration of the system proposed by the writer fifteen years have elapsed and he is now able to publish the results of the behavior, particularly with regard to durability and final economy, of the works during past thirteen years so as to make those data available for the profession. The following are the data obtained from the example of the flexible reinforced-concrete mattress executed in a deep river, that is, bank protection work applied for the lower portion of the Ishikari River (one of the two largest rivers in Japan draining 6,000 sq. miles) where channel depth in front of natural caving bank varies from 25 ft. to 50 ft. at low water stage while it varies from 37 ft. to 60 ft. in flood time. The total length of the protected banks amounts to 35,982 ft.

As is shown in the accompanying table the original cost of the mattress bank protection work is $6.35 per lineal foot or $33,528 per mile and the repair which is done simply by adding a certain amount of new mattress to the width of the mattress originally laid so as to suit the after scour of the river bed costs 15c. per year per lineal foot or $792.00 per mile.

During the years, 1910 to 1922, inclusive, 303,149 sq.yd. of concrete mattress have been applied, the first cost of construction being $1.98 per sq.yd. and the total cost of works amounting to $300,000 in round number.

In investigating what will be the actual annual cost of maintaining the river bank (including original cost and repairs), optionally a term of 20 years (assumed probable durability of the mattress) was adopted as the standard from which the average of both the annual allotment of the first cost and the cost of maintenance and repair per foot of river bank protection works are to be calculated. The interest is not considered, as the works were built and maintained by government funds. The sum of the annual allotment of the first cost of construction and the cost of maintenance and repair is found to be 46.8c. per foot, and is put in the last line of the table so as to make those items and figures comparable with those already itemized in the table in the issue of Oct. 17, 1918, of *Engineering News-Record*, to the effect that with the concrete mattress the cost of annual repair is usually within the sphere of about 50 per cent of the annual allotment of the first cost of construction while with other types the repairing expense far exceeds the cost of first construction.

For the sake of comparison the items concerning the bank protection works of the wharf front at Yingkow, a town situated 14 miles above the mouth of Liao River in Manchuria, China, are inserted in the last column of the table. Here several mixed systems of revetment works are applied, consisting of wooden crib works, fascine mattress, rubble stone pitching, riprap, heavy plank walls and pileworks to the effect that, even with the type of bank revetment which is made of rather heavy and quite expensive construction the cost of repair and maintenance is quite high as the table shows.

These works in Liao River had been tried by the Russian authorities at first, succeeded by the Japanese concerns since 1905. The lapse of 20 years is valuable in making comparison between the behavior of the flexible concrete mattress and that of other types with particular regard to the cost of protecting the bank of a rather large river.

Since the writer's earlier articles were published in this journal he had been requested frequently by the readers of the journal to describe the arrangement adopted by him for laying the flexible concrete mattress with its underlining fascine mat in deep channel separately from the mattress directly laid upon the bank slope and also to give an opinion about the durability of woven wire. Consequently an illustration of the apparatus used for that purpose and conclusions from the experience concerning durability of the wire are added here. The flexible reinforced-concrete mattress was described in *Engineering News* in May, 1912.

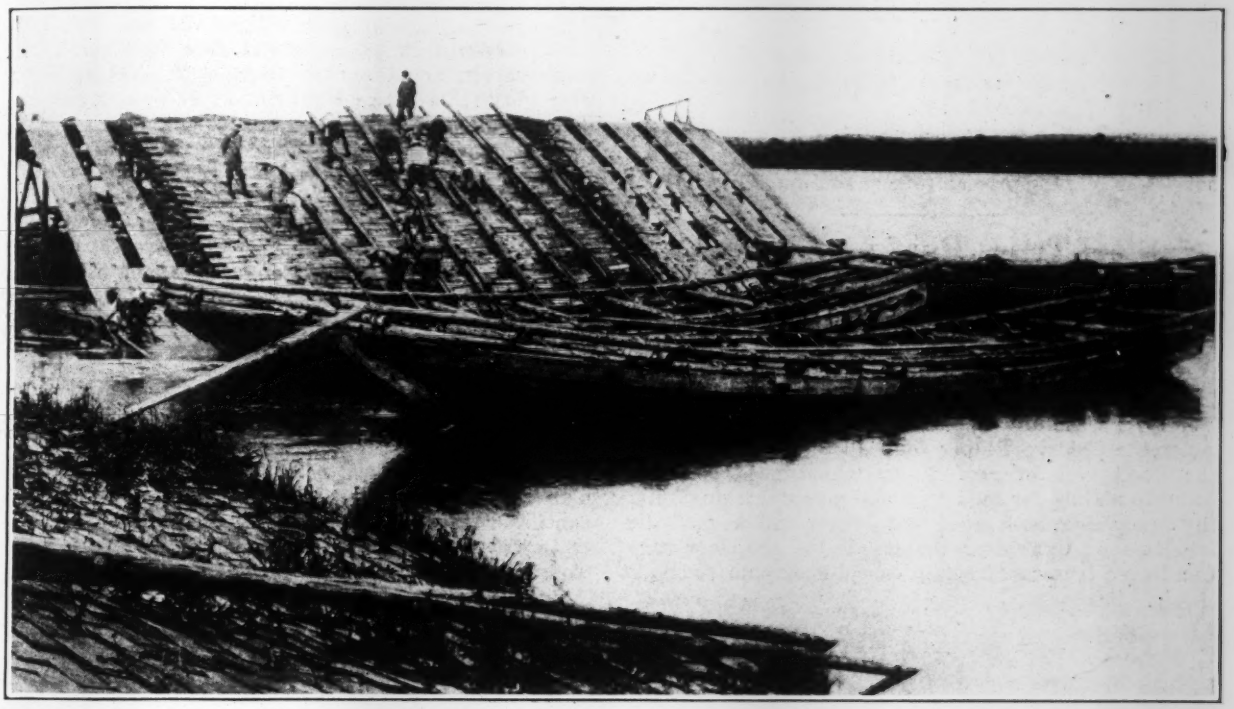
SUMMARY TABLE

Name of River	Ishikari	Liao River
Locality	Ishikari River mouth —Bitoi	14 miles above mouth
Depth of thalweg at low water stage in ft	50—25	30—50
Flood height above low water in ft.	10—12	8—15
Method of construction	Flexible reinforced-concrete mattress with lining of single fascine mat.	Mixed type of fascine mattress, wood crib works, rubble stone pitching, rip raps, plank walls and pile works.
Length of works in ft	35,982	10,866
	U. S. Dollars	U. S. Dollars
First cost of construction per ft. run	6.35	20.47
Annual cost of repair per ft. run	.15	1.135
Allotment of the first cost per ft. run in 20 years	.318	2.047
Sum of allotment and annual cost of repair per ft. run	.468	3.182

Underlining Mat for Concrete Mattress—For a river having a sandy bottom such as in the lower reach of Ishikari River we usually add a layer of underlining

fascine mat 3 in. thick woven with galvanized wire from the start to prevent direct action by the current in attacking the bottom soil through interstices of the mattress. The practice of putting, simultaneously, the mattress and also the underlining mat in 40 ft. or more of deep water may be described as follows: The mattress is put in deep water of any depth in an unlimited length along the river and with any required width, and independently of the mattress directly laid on the bank slope, by using a working or so-called inclined deck pontoon and also weighing pontoons. As shown in the illustration, the underlining fascine mat is knitted on the inclined deck of a big working pontoon capable of loosening the ropes holding the mattress to the pontoons. When a certain portion of the mattress is thus sunk down to the river bed, and therefore the weighing pontoon is relieved of the weight of the hung mattress, divers are sent down to detach the logs (which are to be used repeatedly), so as to make a weighing pontoon entirely free.

When a weighing pontoon is made free it is again sent downstream and located close in front of the inclined deck pontoon as before to serve for receiving and suspending another charge of the mattress, and the same process is repeated. In the view herewith two weighing pontoons in front of the inclined deck are



LAYING CONTINUOUS MATTRESS IN DEEP WATER

accommodating the required width of the mattress. On the finished fascine mat the concrete mattress is knitted and then a certain number of wooden logs, distributed along the length of the mattress, are temporarily and loosely fixed on the mattress by means of free ends of wires previously fixed at certain intervals in order to fasten the underlining fascine mat and concrete mat together. These logs have to be transferred to and hung down from other pontoons, waiting in front of the inclined-deck pontoon, ready to receive the weight of the lowest part of the partially completed mattress in a hanging position, as soon as the lowest part of the mattress is, bit by bit, allowed to slide down along the inclined deck into the water by letting the inclined deck pontoon go downstream gradually to clear the upper portion of the inclined deck of the finished part of the mattress. This makes it possible to continue the operation of extending the length of concrete mattress by working on the cleared portion of the inclined deck.

When the length of the finished extended out portion —that portion of the mattress already taken to and hung from the floating pontoon—is sufficient to reach the river bottom the hanging portion of the mattress is let down gradually so as to lie on the river bottom, by weighing the finished portion of the mattress while the third pontoon on the right is moving close to the inclined deck in order to be ready to receive the next portion of the mattress, as the construction of the mattress on the inclined deck progresses. By repeating such process the continuous mattress can be set to any length.

The scaffold was designed by K. Sakamoto, assistant engineer on the Ishikari river improvement works.

This method is used for laying apron mattresses of unlimited length in front of caving banks, and in deep water, so as to protect the foot of the bank protection mattress laid directly on the bank slope when any probable future scour would occur close to the shore. In a river having sandy bottom, as in the Yellow River, it is preferable to provide sufficient width of the apron mattress beforehand than to supplement it afterward.

Making and Sinking Mattress for Bank Slope—To prepare and set the mattress for the underwater portion of a bank slope we usually apply what we call a "pontoon hung log scaffold." This process was fully illustrated in the article of March 13, 1913, and will not be repeated here.

The apron mattress of sufficient width provided beforehand (or afterward, it being optional as to whether

the apron or the bank slope mattress shall be laid first) in front of the caving bank in combination with the bank-slope protection mattress may now form a complete bank protection work and requires little aftercare. Any further scouring may be dealt with by the natural settling down of the protection work to suit the scouring of the bed by making the upper end of the mattress free when first laid to allow it to slide down when threatened from the toe. In other words, we provide no means of checking downward motion of the mattress. The settled or slid down mattress must be supplemented as soon as possible in order to protect the portion of bank slope thus exposed by the settlement of the mattress.

Durability of Wire—In fresh water we use No. 4 galvanized steel wire although copper wire has been used in salt water to prevent its rusting. As to the durability of galvanized steel wire there exists diversity of opinion but in my experience such wire used in the works under my charge in Japan fifteen years ago has not yet suffered appreciably from rusting.

Steel Truss Roof for Chicago Riding Club

Light and Ventilation Factors in Design—Upper Floor Hung from Transverse Cantilever Trusses

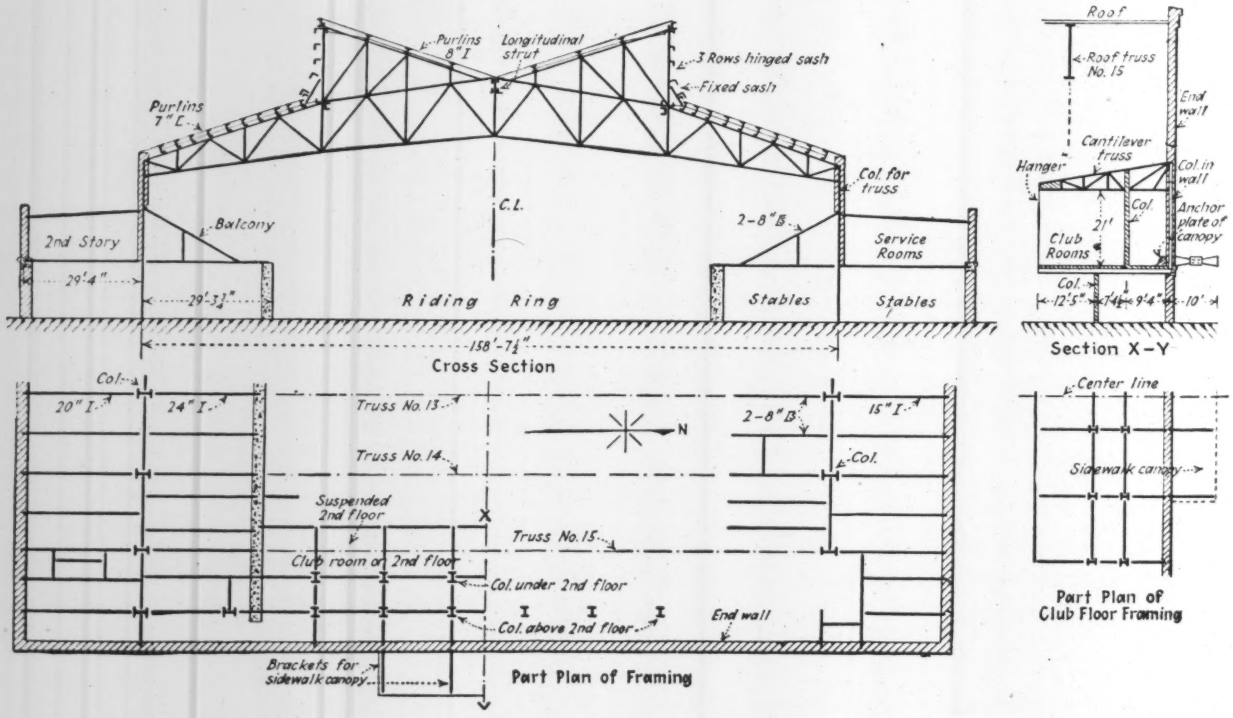
IN THE structural design of the steel frame building for the Chicago Riding Club a prominent feature is the Pond type of roof truss, which has been used hitherto mainly for industrial and manufacturing buildings requiring both good ventilation and a good distribution of light over the middle of the floor area. Cantilever trusses carrying second-floor club rooms at one end of the building form another special feature of the building, which is 305x218 ft. in plan. The roof and framing plan are shown in the accompanying drawing.

Since no intermediate roof supports were permissible within the arena or ring, or in the balconies which flank it, roof trusses of 158 ft. 7½-in. span were provided, supported on columns which also carry the rear framing of the balconies and of outside two-story structures for stables, offices and service purposes. The trusses, spaced 18 ft. 8 in. c. to c., carry I-beam purlins. Four pairs of the trusses have diagonal lateral bracing, and two lines of horizontal struts are also framed between the columns.

The central portion of the roof forms a wide and lofty monitor providing ample light and ventilation. It will be seen that each vertical face is divided into three panels, and these are fitted with steel sash and wire glass; the entire length of sash in each panel is hinged at its upper edge and swings outward for ventilation. Below the vertical face is an inclined panel which is fitted with wire glass in stationary sash. Precast concrete slabs and tiles form the roof of the monitor and the side slopes.

The balcony framing consists of horizontal I-beams carried by the side framing and arena wall, each beam supporting an inclined girder composed of a pair of channels upon which is the 3-in. stepped concrete deck for the seats. This deck, with 20-in. risers and 32-in. treads, is designed for 100-lb. live-load. The exterior flanking building has floor and roof beams attached to the main framing and seated in the outer walls, as shown.

Inside the north end of the building are offices and club rooms, with an upper floor which is roofed by cantilever trusses below and at right angles to the main trusses, as shown at the right of the drawing. To avoid supporting columns in the arena, the outer end



FRAMING OF RIDING CLUB BUILDING UTILIZES ROOF TRUSS TYPE COMMONLY USED FOR INDUSTRIAL BUILDINGS

of this second floor is suspended from the cantilever trusses. Minor structural features are the 10-ft. cantilever girders for the canopy over the sidewalk at the east end, shown in the drawing, and a suspended music gallery at the west end. The floor beams for this gallery are seated in the end wall and have their outer ends suspended from one of the roof trusses.

In erection, each main truss was delivered in two sections, assembled at the site and then hoisted into position by a timber traveler moving along the ground on rollers. This traveler had a tower 40x40 ft. and 40 ft. high, with two 85-ft. booms of 15 tons capacity, giving a maximum lift of 110 ft. under the hoisting blocks. Two steam hoists, mounted on the bottom deck of the tower and serving as ballast, were used also.

Concrete piles cast in place form the foundations. For the riding ring, upon a 12-in. layer of rolled clay fill on the earth subsoil is placed 8 in. of tan-bark.

This riding club building was designed by A. N. Rebori, architect, of the firm of Rebori, Wentworth, Dewey & McCormick, Inc.; Julius Floto was structural engineer. The general contractors were Bulley & Andrews and the steel was fabricated by the Morava works of the McClintic-Marshall Co., Chicago.

Impact Stress in Concrete Pavement by an Electric Strain Gage

Stress-Strain Law Assumed to Apply to Impact so that Stresses Are Determined from Areas under Recorded Curve

By D. D. McGuire
Assistant Engineer of Tests, Tennessee Department of Highways and Public Works

RECENT investigations show that truck impact is merely a very quickly applied static load, and, therefore, the stress is proportional to the strain. From this assumption the problem is to determine the exact deformation.

In any gage for recording impact deformations, there can be no moving element depending upon bearings for its action; neither can there be a moving part having appreciable mass. If bearings are a factor, an error appears from the fact that the most careful machining cannot be more accurate than 0.0005 in. Where there is mass, there is bound to be inertia when a sudden blow is applied, and a consequent "overthrow." The gage described here is planned to eliminated these objections.

Briefly described, the gage is a magnet, properly aged, rigidly attached to the concrete in a depression cut to receive it. The instrument is placed as near as possible to the top of the pavement slab in order to indicate the maximum stress encountered. It is about 5 in. long and somewhat over 1 sq.in. in cross-section. On each end of the magnet there is a soft iron core wound with 8,000 turns of No. 48 copper wire. A diaphragm of sufficient thickness to afford rigidity is fastened to the concrete at the other end of the depression and is adjusted so that it is close to the ends of the magnet, allowing only clearance for the maximum movement.

FIG. 1—MAGNETIC DEVICE FOR IMPACT MEASUREMENT, PLAN VIEW

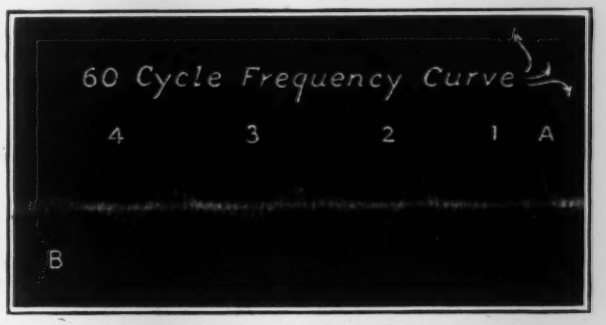


FIG. 2—IMPACT RECORD ON DRUM OF OSCILLOGRAPH

As the diaphragm approaches the magnet, the number of magnetic lines of force are increased and induce a potential in the coil. If the load is applied slowly enough, the potential so induced may be read on a galvanometer. If the load time is too fast, this potential must be impressed on the grid circuit of a calibrated hot-tube amplifier such as is used in radio circuits. The plate current variations may be read on an oscillograph and the smallest movement of the gage may be faithfully recorded. Movements of 0.000003 in. have been easily read.

Fig. 2 shows the oscillogram from this gage made by dropping an 8-lb. weight 1½ in. on 3x3-in. concrete beam with a span of 16 in. The top curve is for 60-cycle frequency used to time the oscillogram. The area under the curve at *A* is proportional to the deformation of the beam when the weight struck it. The beam, after the blow, vibrated in its natural period at approximately 2,000 cycles per second. At *B* it may be noted that there is a complete reversal of this movement, and the area under the curve represents the deformation when the beam returned from the effect of the blow. That the areas *A* and *B* are not equal is due to the fact that the weight was allowed to remain on the beam and caused some deformation due to a static load. The numbers 1, 2, 3 and 4 indicate the harmonics of the beam system while vibrating in a depressed condition. Upon close examination, there can be found a secondary curve made during successive revolutions of the oscillograph drum. This is caused by the insecure connection between the concrete and the gage during experimental work and is easily overcome. If it were impossible to eliminate this factor, still the results would be valuable, for this effect comes after the deformations in which we are interested are past.

Further investigation should develop this apparatus into an exact means of determining the effect of impact blows. Since the gage is compact it may be placed in the concrete immediately under the wheel of a truck. Also since its construction is free from inertia and mechanical movement in bearings, and its theory is based on fundamental principles of physics, its results are faithful.

Acknowledgment is made to George Francis, to J. S. Martin of the Sangamo Meter Works, and to Hugh Brown of the University of Illinois for aid and advice in the development of this device.

Sewage Sludge Marketed for Three Years at Schenectady, N. Y.

Information on Value and Methods of Use Spread Among Farmers and Gardeners with Aid From Farm Bureau and Press

By Morris M. Cohn
Superintendent, Bureau of Sewage Disposal, Schenectady, N. Y.

A SUCCESSFUL attempt made at the sewage-works of Schenectady, N. Y., to interest the farmers of the vicinity in sewage sludge as a fertilizer bids fair to result in the disposal of the entire yearly output by this method in the near future. The promise of a growing sludge market for the first time, after more than ten years of operation of the plant, is noteworthy and bespeaks marketing methods more potent than the other sporadic attempts made to place the fertilizer before the eyes of the farmers. In view of this fact, it should be of interest to other plant operators to know something of the methods of sludge production, the methods used in creating a market, and the actual fertilizer results obtained by the farmers as described in the following.

FARMERS LOADING SEWAGE SLUDGE INTO THEIR MOTOR TRUCKS AT SCHENECTADY, N. Y.

Sludge Production—The settling solids in the Schenectady sewage are removed in major part by sedimentation in nine Imhoff tanks and pass into the digestion hoppers. The digested solids are drawn from the tanks, under hydrostatic pressure, through sludge piping and gates and flow by gravity to a 5-hp. vertical centrifugal pump that forces them through a pressure main to 13 sand and gravel drying beds with tile underdrains. Five of these units were constructed with the rest of the plant and have a total area of 0.29 acres, equivalent to 0.19 sq.ft. per capita, and the other eight beds were constructed in 1920 and first used in 1924, and have a total area of 0.58 acres, equivalent to 0.38 sq.ft. per capita.

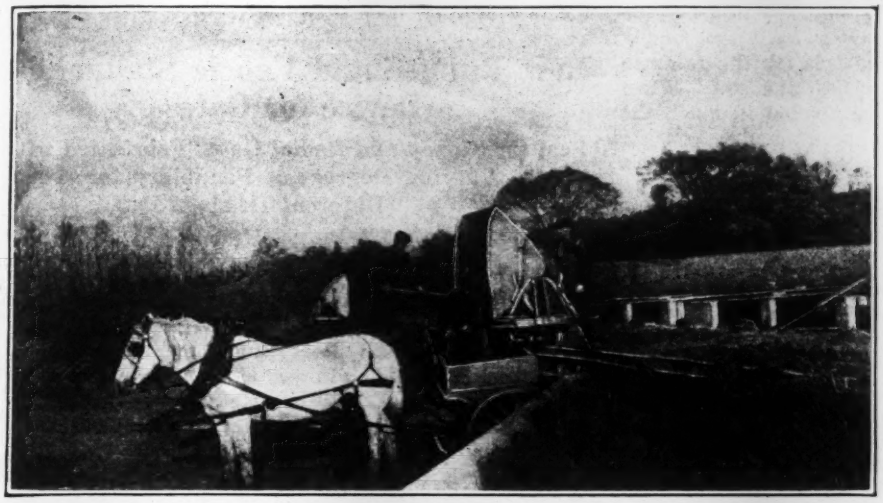
During the summer of 1924 a total of 6,823 cu.yd. of wet sludge were drawn to the beds and in the summer of 1925 8,847 yd. of wet sludge were dewatered. This sludge has an average specific gravity of 1.01, a moisture content of 95 per cent, and a 65 per cent organic matter content. It is well digested and contains much gas. It is pumped onto the sand beds to an average depth of 12 in. and always cracks within 48 hours in normal dry weather. The sludge dries to a forkable condition in about a week in the warmest part of the summer but takes much longer to reach this state under unfavorable temperature and precipitation conditions. The shrinkage in volume of the wet sludge varies from 50 to 80 per cent and averages 65 per cent, and the dried cake that is removed from the beds is from 4 to 5 in. thick, contains from 60 to 70 per cent moisture and is easily handled with a 6-tine fork. It is loaded onto a 1½-yd. side-dump car on industrial track and switched to a dump platform, where the load is transferred to a Watson dump wagon which hauls the sludge to the fields or the storage piles. A total of 2,287 cu.yd. of this air-dried sludge was produced in the summer of 1924 and 2,848 yd. during the summer of 1925.

Analysis of the sludge stored in the fields indicates that it contains from 0.33 to 0.98 per cent nitrogen, which is equivalent to 0.40 to 1.19 per cent of ammonia, from 1.50 to 1.81 per cent total phosphoric acid, which is equivalent to 3.25 to 3.94 per cent of bone phosphate of lime. It contains roughly 54 per cent organic matter and 5 per cent ether soluble matter. The moisture is reduced to about 45 per cent by the action of the air on the storage piles. Analyses indicate that weathering does not greatly decrease the fertilizer constituents in the sludge and has the advantage of drying and puiverizing it and rendering it more available as a plant food. Most of the grease is removed by the aid of rain and sunlight. The sludge shrinks considerably in the storage piles, decreasing the volume that can be offered for sale.

Past Method of Disposal—In the past, no prolonged attempt was made to market the sludge to the local farmer. An ordinance passed by the common council in 1915 "authorized the commissioner of public works to sell the sludge produced at the sewage disposal plant at a price to be determined by the demand." A number of loads were sold to farmers at that time but no real interest was evinced and the market ceased. Attempts to give the material away failed and the sludge was from then on used exclusively to fill low spots at the plant site. Much sludge was spread on the land and plowed under. The plant was out of operation from May, 1920, to November, 1921.

Producing a Market for Sludge—In the summer of 1924, I decided to make a strenuous effort to bring the good qualities of sludge as a fertilizer to the attention of the local farmers. Metcalf & Eddy, consulting engineers of the plant, suggested that a nominal price per load be charged to introduce the material in the locality. I wrote letters of inquiry to farm bureau managers and agricultural experts in many parts of the country and

a number of these officials returned favorable comments on the use of sewage sludge in their vicinities. A sample of sludge was sent to the New York State College of Agriculture, Department of Agronomy, which reported that "on the basis of the analysis the sludge would contain 8 lb. of ammonia per ton, or the amount of ammonia contained in 45 lb. of nitrate of soda or in 32 lb. of ammonium sulphate, and that it would contain 30 lb. of phosphoric acid or the amount that would be present in 190 lb. of 16 per cent acid phosphate." The College also wisely pointed out that the organic matter contained in sludge was a factor of value which should not be overlooked, but that the oils and fats which sludge contains are not infrequently detrimental to plant growth. Farmers "could well afford to haul this material if furnished them free of charge," the report said, but it is "difficult to state how much they could afford to pay for it."



TRANSFERRING SLUDGE FROM DUMP CARS TO WAGONS FOR HAULAGE TO STORAGE PILES IN THE FIELD

This information, with a compilation of all other available material on the use of sludge as a fertilizer, was placed before the manager of the local farm bureau association who had never seen sewage sludge and knew nothing of it. He was convinced that the sludge was worthy of a trial by his constituents in view of the fact that there was a great need for cheap fertilizers, and that the farmers were not much in favor of using commercial fertilizers. He promised the aid of his bureau and half the battle was won. Articles about sludge appeared in the local press and in the papers printed in the towns and villages about the city. The farm bureau sent out a form letter to its constituents acquainting them with the fertilizer qualities of the sludge and recommending that they try it. The official paper of the farm bureau carried an article on sludge and the manager personally told many farmers of the material. Exhibit samples were attractively made up to be displayed at meetings of the farm bureau and the market gardeners' associations and in a remarkably short time the idea was sold to the local producers. I addressed a farm bureau meeting held in a village near the city on the merits of sludge and have been invited to address other gatherings from time to time. A few farmers appeared at the sewage-works and inspected the material. I spent much time with each farmer, explaining how to use the material and convincing him that sludge was what his land needed. The word passed from farmer to farmer and sludge began to leave the storage piles. The first real market for sludge at Schenectady had been made, thanks to the power of advertising.

Sale of Sludge—The demand for sludge at Schenectady should continue to grow and should soon equal the output of the plant. To Aug. 1, 1926, about 75 farmers from every section of the county have purchased sludge. The price originally charged was 10c. per load, irrespective of the quantity removed, which saved the time and added expense of measuring every load drawn. This spring the price was raised to 25c. a load without noticeable decrease in the demand. It is estimated that the average load drawn contains about 2½ cu.yd. of sludge, which weighs from 1,000 to 1,500 lb. per yard. The average haul is about six miles, the longest being 15 miles. The farmers load their own trucks from piles in the fields but have the privilege of loading from the sludge bed dump cars when the plant operators are working on the drain areas. To date, a total of 820 loads have been sold at 10c. and about 150 loads have already been removed at the increased price, making a total sale of practically a thousand loads or some 2,500 cu.yd. of dried material. It is encouraging to note that the farmers who drew the first year are returning for greater quantities of the fertilizer and that their neighbors are coming with them.

During the winter of 1924-5 ten drying beds were covered with partly dried sludge and the farmers removed this accumulation, breaking the frozen sludge into pieces with picks and loading it into the dump cars. It is estimated that the cost of sludge removal at Schenectady is over $20 a bed, including team hire, so that this phase of the sale saved the city some $200 and left the beds ready to receive fresh sludge at the advent of warm weather. The sale of sludge also saved the city the expense of plowing the sludge under the ground, or otherwise disposing of the material.

In the fall of 1925, some 500 yd. of sludge remained on the thirteen drying beds. This was removed by the farmers as in the previous winter at an estimated saving to the city in labor of over $250. Many householders of the city have taken a few bags of sludge for gardens and lawns, no charge being made for this quantity.

Sludge as a Fertilizer—The local farmers were impressed with the sludge even before the results of its use were visible. It has a rich color, looks much like barnyard muck, has heat and a slight odor, which farmers associate with all natural fertilizers, and handles easily. The large crop of healthy tomato vines that covered the sludge piles at the plant impressed the farmers and, contrary to expectation, they do not fear these weeds, which they term "pleasant weeds." But most of all they are sold to the sludge idea because of

the excellent crops that it produces for them. The rainy summer of 1924 was especially fortunate for the sludge sale.

The local purchasers of sludge used it on both sandy and clayey land, with equally good results. It was applied in three ways: (1) Broadcast from a wagon or manure spreader; (2) spread in the prepared drills; and (3) placed directly in the hills. When spread broadcast, it was applied in a fairly heavy coat of 30 to 40 cu.yd. to the acre, plowed under and then dragged. Sludge used on sandy land had a tendency to disappear from sight a few days after plowing, so it was simply spread on top of the ground and left for the rains to carry the fertilizer constituents into the soil. When used in drills and in hills it was applied in much the same manner and quantities as horse manure.

Great success was reported with all types of crops. One farmer reported the best crop of hay he had had in years; another had the best strawberry yield of the entire section. When spread broadcast, such crops as potatoes, corn, beans and all greens were greatly assisted. Placed in hills it produced excellent cucumbers, cabbage, kale and tomatoes. When spread in drills it aided beans, peas and potatoes. Success was reported with rhubarb, asparagus and eggplant. The farmers think that it acted as well as horse manure and parallel rows of sludged and unsludged crops showed distinctly the advantage of sludge. Slightly less success was reported with sludge than with commercial fertilizer costing $40 a ton, but the farmer in question looks for continued benefit from sludge next year while his commercial fertilizer simply gave an initial impetus to his crops. Many farmers used the sludge about their fruit trees and were satisfied with the results obtained, and still others improved young blackberry and purple berry bushes with sludge. Experience indicates that sludge should be delivered to the roots of the crops, and that depth of application thus depends on depth of roots in the soil. The writer informed each purchaser of sludge to avoid using the material on any crop that grew in or on the ground and was eaten raw.

Used in garden patches at the sewage-works, it produced double the crop of potatoes and oversize cabbages. Cornstalks grew two feet higher and the ears were large and solid. Alternate rows of sludged and unsludged beans proved the value of the fertilizer. Flower beds about the plant site, prepared with horse manure and sludge, produced the finest flowers ever grown here. Householders about the city were pleased with the way the sludge acted on their lawns.

Two florists used sludge with excellent results in pots and greenhouse bins. Their experience indicates that a 30 per cent sludge and 70 per cent soil mix should not be exceeded, unless the plants are to be kept saturated at all times. These florists reported success with such plants as geraniums, pansies, carnations, tulips, etc., and are now drawing sludge for compost piles to be made of grass, sod and sludge.

In view of these excellent results, it is expected that the demand for sludge will increase. Loading of the material from the storage piles in the fields is slow and uncertain, due to the poor traction afforded the wheels of heavily-loaded trucks. If the market warrants increasing the price of sludge slightly, it is planned to construct an elevated trestle, purchase a gasoline engine to haul the dump cars, and store all of the sludge in a large pile on a concrete loading platform.

The prevalent custom of using sludge to fill in the low spots about a sewage-works and of allowing the material to accumulate in piles about the site is an economic crime, unless an honest attempt has already been made to interest the producers in the vicinity of the treatment plant in the fertilizer value of the product. It is hoped that the above explanation of the marketing methods used at one sewage plant will be of assistance and act as an incentive to other operators to attempt to dispose of the sludge produced at their plants to the farmers that need it so badly.

New Rubber and Fabric Staunching Device for Gates

Seal for Stoney and Radial Gates Fabricated with Varying Degrees of Flexibility for Different Heads

By Julian Hinds
Recently Assistant Designing Engineer, U. S. Bureau of Reclamation, Denver, Colo.

A NEW type of staunching device has recently been developed for radial and stoney gates which promises largely to replace metal staunching rods, split hose, rubber-belting seals and other similar means for securing watertightness. The new seal is of rubber and cord fabric, the construction being similar to that used for automobile tires.

The details and dimensions of the seal, which was developed by the U. S. Bureau of Reclamation, may be varied as required for individual installations. Three proposed types are shown in Fig. 1, with considerable variation in rigidity. The insertion of the fabric core gives type A the rigidity necessary for heavy duty under high heads. In type C the core is omitted, its place being left empty. This results in a marked increase in flexibility, making a tight closure possible under light pressure. Type B is intended to be intermediate in flexibility between A and C, the core space being filled solid with cushion stock.

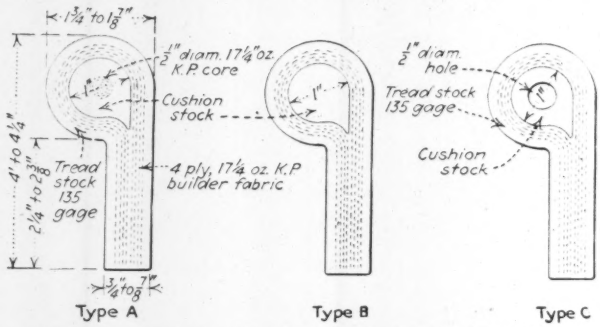


FIG. 1—RUBBER SEALING STRIPS FOR STONEY AND RADIAL GATES

Seals so far installed by the Bureau of Reclamation have been of type A with dimensions shown in Fig. 1. Operation has in all cases been satisfactory, although the heads have been such that a more flexible type would probably have been equally suitable. A type C seal has been constructed by the B. F. Goodrich Rubber Co. for a private corporation, to dimensions shown in Fig. 1, but to slightly different specifications. No information is available to the writer as to the performance of this seal. Visual inspection of a small sample indicates a desirable degree of flexibility for low-head work, and

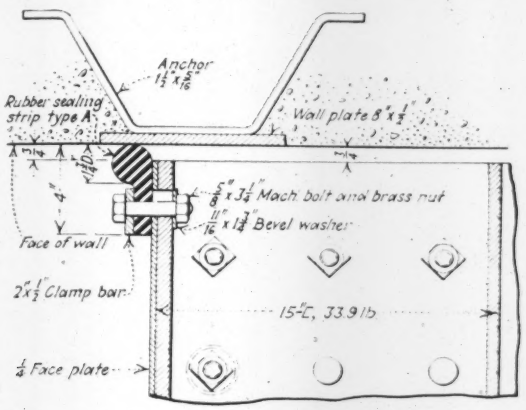


FIG. 2—END SEAL FOR RADIAL GATE AT McKAY DAM
Gate size is 20x10 ft. and maximum head, 10 ft.

it may be found sufficiently rigid for reasonably heavy duty.

The type B seal is probably the cheapest of the three types shown. The introduction of either the cord core or the hole is understood to complicate the construction. The rigidity of type B can be controlled to a limited extent by changing the specifications for the cushion stock core, and it is possible that this type will be found adequate for practically all uses.

Fig. 2 shows the application of the device to the 20 x10-ft. radial gates now being fabricated for the spillway of the McKay dam, near Pendleton, Ore. The bolts which hold the seal in place pass through slotted holes in the face of the gates. This permits ready adjustment. Fig. 3 shows how the seal is to be applied to a

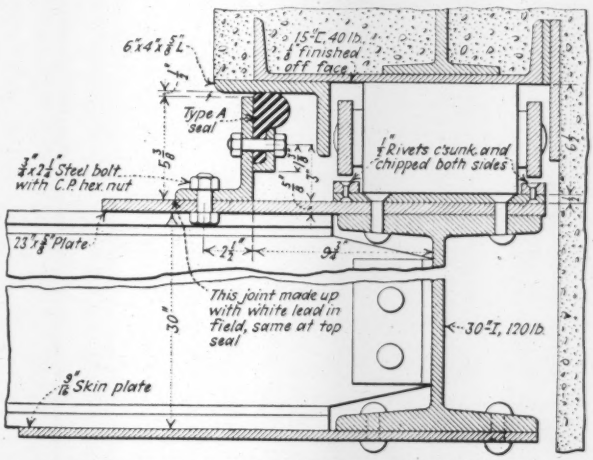

15-I, 40 lb.
finished off face
Type A seal
Rivets csunk and chipped both sides
Steel bolt with C.P. hex. nut
Plate
This joint made up with white lead in field, same at top seal
30-I, 120 lb
Skin plate

FIG. 3—SIDE SEAL FOR STONEY GATE AT GUERNSEY DAM
Gate size is 20x26 ft. and maximum head, 60 ft.

20x26-ft. stoney gate which will control the power inlet at the Guernsey dam in Wyoming. This gate will be submerged normally and will require a seal across the top which accounts for the location shown for the side seal. The top and side seals are to be mitered and vulcanized together at the corners, to form a continuous water stop. The maximum head on the Guernsey gate will be 60 ft. For a non-submerged stoney gate, where a top seal is not required, the side seal should be attached to the upstream side of the face plate, as shown for the radial gate in Fig. 2, in order that the rollers will not ordinarily be submerged. The gates from which Figs. 2 and 3 are chosen are now being fabricated and the seals have been purchased. Examples are chosen from these installations rather than from structures already in operation to show the latest connection details. The first installations were provided with more elaborate means for adjustment, which, although convenient, have been found not to be essential. The operation of the seal has been thoroughly tested on three 15x16-ft. radial gates controlling a sand sluice at the headworks of the Fort Laramie Canal, on the North Platte project, Nebraska-Wyoming.

The original specifications for the device, which were developed in collaboration with the Gates Rubber Co. of Denver, have been slightly revised to meet the objections of other manufacturers, the final form being:

Core—The core should be made of 16- to 18-oz. Karded Peeler builder fabric, or American cotton fabric, impregnated, frictioned both sides and skimmed one side to a gage of 0.047 in. and made into a compact roll ⅛ in. in diameter, from a full length strip, in such manner as to keep all cords parallel (for type A only).

Reinforcement—The reinforcement shall be made of four plies of 16 to 18-oz. Karded Peeler builder fabric, or American cotton fabric, impregnated, frictioned both sides and skimmed one side to a gage of 0.047 in.

Cushion Stock—The cushion stock shall consist of highgrade stock, containing not less than 90 per cent by weight and 96 per cent by volume of new plantation rubber free from reclaim, whiting silica and other coarse material, balanced in compound to permit thorough cure. Tensile strength shall be not less than 2,500 lb. per sq.in.; elasticity not less than 700 per cent.

Tread Stock—The tread stock shall consist of highgrade stock containing 50 per cent by weight and 70 per cent by volume of new plantation rubber free from reclaim, whiting, silica and other coarse material, balanced to permit thorough cure. Tensile strength shall not be less than 3,000 lb. per sq.in. and elasticity not less than 600 per cent.

General Notes—The different elements shall be well cured and well bonded together so as to withstand the separation tests generally specified for high quality pneumatic cord tires. The surface finish shall have no variations, from smooth to rough, more than $\frac{1}{16}$ in.

Length—The rubber seal of the above cross-section shall be fabricated in unbroken lengths as required.

Ontario Ry. to Cross Quebec Crown Land

The Privy Council of Great Britain recently dismissed the appeal of the Province of Quebec against a decision of the Supreme Court of Canada in which the latter court ruled that the Nipissing Central Railway Company, a part of the government owned railway of Ontario, the Temiskaming & Northern Ontario, had the right to occupy Crown land in Quebec for the purpose of constructing a branch line into the Rouyn gold fields. This Ontario railway planned to tap the recently developed gold fields in Northwestern Quebec. It intended to do this by extending the line of its subsidiary, the Nipissing Central Railway across the interprovincial boundary into Quebec, basing its right to do so upon the original charter of the Nipissing Central which gave it the right to build in Quebec as well as in Ontario. In order to reach the gold fields the new railway would have to cross "crown land," land belonging to the province of Quebec. When the railroad reached the interprovincial boundary its construction was stopped by the province of Quebec on the ground that it could not build across these lands without authority from the provincial government of Quebec. The Supreme Court of Canada ruled against the provincial government of Quebec, the case was taken to the Privy Council which sustained the court ruling.

Effective Form-Handling Cableway at Philadelphia Stadium

New Municipal Stadium Seats a Hundred Thousand —Reinforced-Concrete Framed Horseshoe and Notable Pile Foundation

FORM handling normally is the controlling operation in building a concrete frame stadium. Whether of the bowl or horseshoe type, the yardage of concrete per unit of area is so moderate that, with very ordinary means, its placing can be made to keep pace with any practicable speed of progress of other operations. An example is the Philadelphia Municipal Stadium illustrated here which, with a projected area of 1,600x175 ft., contains less than 20,000 cu.yd. of concrete. In contrast there are something like 100,000 lin.ft. of columns and girders and 410,000 sq.ft. of floors for which, largely, forms have to be provided. Or, for each of the 40 construction "sections," the comparative tasks are: (1) To mix and pour 450 cu.yd. of concrete and (2) to move from a section previously concreted, set up and take down forms for 2,500 lin.-ft. of columns and girders and for 10,000 sq.ft. of floors. Obviously in such case, form handling becomes the factor for critical consideration in the problem of construction economics.

Structurally the new stadium at Philadelphia, beyond the information presented by the illustrations, will not be discussed except to note that the architects, Simon & Simon, of Philadelphia, Pa., have made it everything that is modern in construction and equipment. The exterior wall is brick broken by a series of arch entrances and crowned by a parapet of limestone. A fair idea of the architecture is had from the view, Fig. 1. The structure will seat 100,000 persons. The cost which is officially given out is $2,000,000. The plan is a horseshoe, divided into 40 sections by transverse joints and these again into dual sections by an axial joint from tip to tip of the horseshoe. These sections are indicated by the drawings, Fig. 2. The stadium is a municipal building constructed under the direction of the Philadelphia Department of Public Works, George H. Biles, director. It is located on South Broad St. just north of League Island on a portion of the undeveloped park area which is temporarily the site of the Sesquicentennial Exhibition.

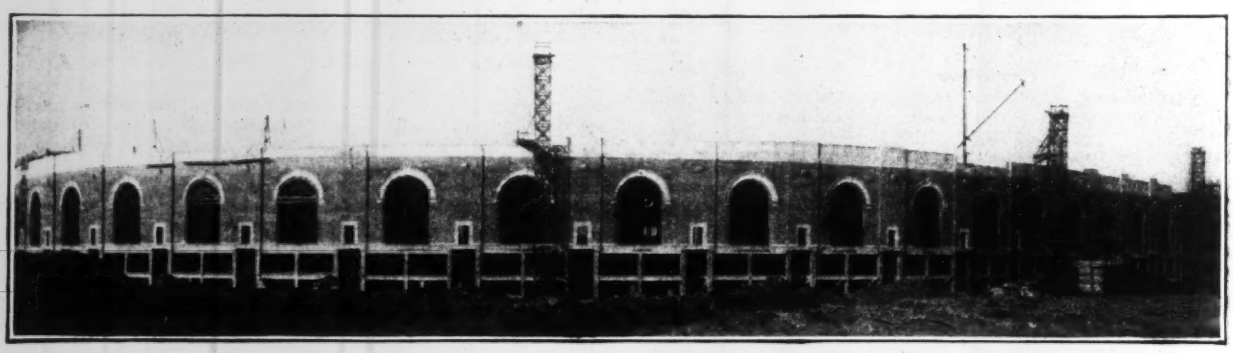


FIG. 1—ARCHITECTURAL TREATMENT OF PHILADELPHIA MUNICIPAL STADIUM
Fill will be brought up to the level of the arch entrances concealing and in part burying the framework now visible.

Foundation Construction—The site to be built on was marsh land at elevations of 0 to +5. The plan put the athletic field level at El. +5 and provided for filling

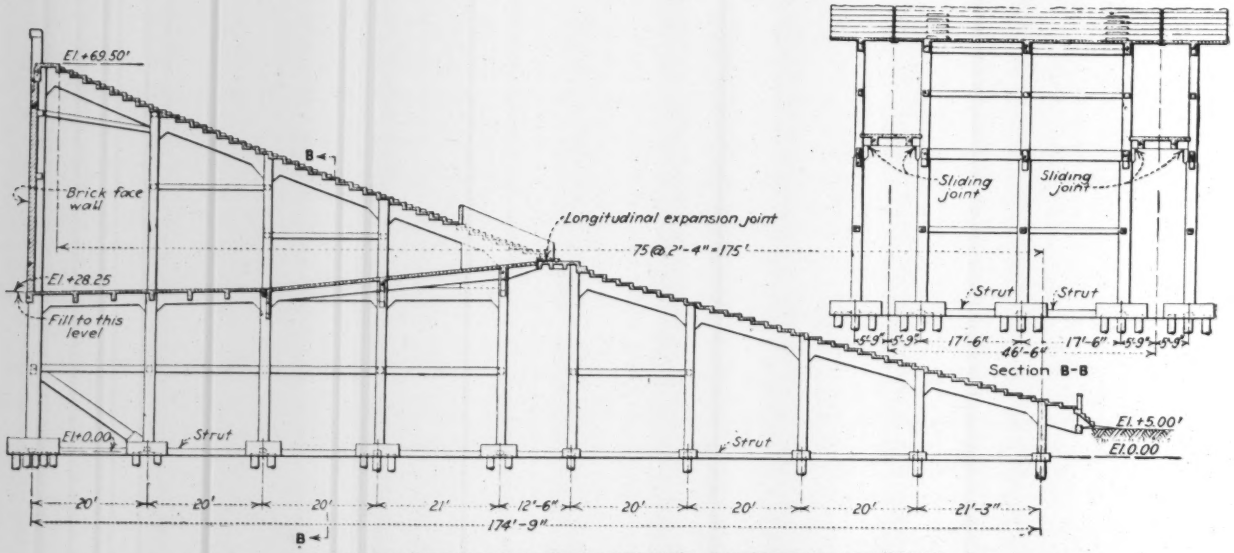


FIG. 2—SECTIONS OF PHILADELPHIA MUNICIPAL STADIUM
The cross-section is taken through the structure at an entrance portal; beam members shown for "straight sections." Piles, caps and cap struts put in under separate contract. Note expansion joints dividing horseshoe into sections.

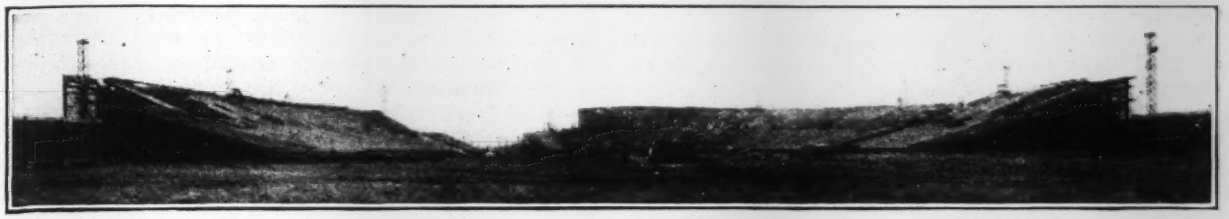


FIG. 3—VIEW SHOWING EIGHT CONSTRUCTION TOWERS ON PERIMETER OF STRUCTURE
These towers carried the cableway for handling forms; three of them had mixing plants and concrete hoists and the others had cages for brick and general purposes.

outside the horseshoe to El. 28.5. These elevations in respect to the structure may be seen from Fig. 2. The foundation feature to be observed is that the column footings were at about El. 0. The land is marsh soil to a depth of some 20 ft., and then gravel fining down to sand at greater depths. The obvious foundation design under the conditions was column footings on piles; but, before this was determined on, tests of several pile footings (full size) were carried out. The developed design was: Clusters of two to eleven concrete piles molded in place capped with concrete and braced between caps two ways by concrete struts. This construction is indicated in Fig. 2.

The foundation construction operation was then to drive in clusters some 4,300 pile shells, fill then with concrete and build concrete caps and struts. The ground was soft, but not particularly wet, so that while some roadway construction was required it was not of extraordinary amount and six pile-shell-driving rigs and concreting outfits were run onto the marsh without trouble. The 4,300 piles were put in in 50 days. The shells were 16 in. and were driven till the penetration was less than ¼ in. per blow under the last eight blows of a 3,000-lb. hammer with an effective drop of 15 ft. A record in driving with six rigs was 260 piles in 24 hours. The contractors for the foundations were McCloskey & Co., Inc.

Superstructure Construction—Around the outside the stadium is about 1,800 ft. It is divided into 40 dual sections by the joints previously mentioned and a section was taken as a construction unit. As pointed out, form handling was the primary problem. This handling, comprising erecting and taking down a set of forms included transfer from a preceding section since it was economy to use one set as many times as it could be used. None of the form units was very heavy. Some of the girder and column boxes weighed up to perhaps half a ton but this was a maximum. Power was needed to handle some of the forms but not very great power—rather some light quick-acting mechanism for moderate loads. The device hit upon is illustrated in Figs. 3 and 4.

Around the outer perimeter of the horseshoe eight timber towers were erected 250 to 300 ft. apart, as shown by Fig. 3. These towers were strongly guyed—as many as eight cables being used on some of them. Then a cable was strung between tower tops, and on it between each pair of towers a traveling block was hung, with hauling lines to the towers. From the block a cable was carried down on a slant to a deadman within the horseshoe. A block and fall was attached to this inclined cable. Fig. 4 indicates the arrangement very well. It will be seen that by hauling the traveling block right or left, the incline cable and its block and fall, pivoting on the deadman, swings to "cover" the area of a section where forms are being handled. This device was found strong enough and quick acting—in fact it was successful in every particular. A trial of it had been made in building the Brown University stadium, but it was first used at Philadelphia as a planned method of form handling for stadium construction.

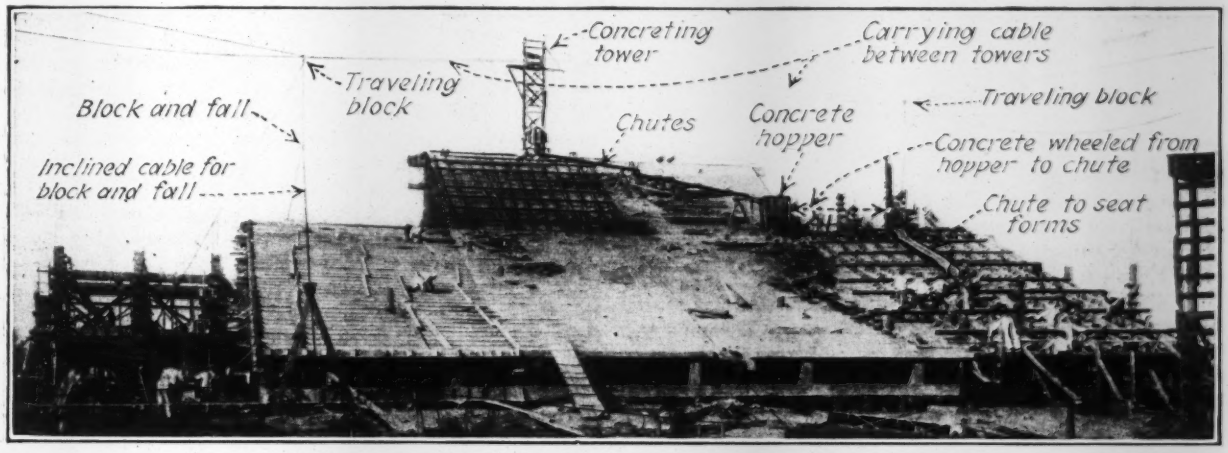


FIG. 4—ARRANGEMENT OF CABLEWAY AND TACKLE FOR HANDLING FORMS

Besides supporting the carrying cable for handling forms, the towers were arranged to handle materials. At three of them mixing plants were set up; these consisted of a six-bag mixer, bins and the usual outfit of a tower hoist. From the towers the concrete was distributed by wheeling, using troughs for final distribution where they were advantageous. The concreting towers were selected so that concreting both ways from

each, the horseshoe was divided into six equal wheeling distances for concrete. The remaining five towers were outfitted with hoists and cages for handling brick, parapet stone and other materials.

Turning again to form handling the point calls for emphasis that only the heavier framework forms were moved by the cableway. Light forms for the seat banks were more quickly shifted by hand and were so handled. The principle is that speed in form work is precedent to any saving of hand labor which cuts down speed. Some notable records of progress were made on the Philadelphia work.

Quantities and Progress—The quantities of principal construction materials in superstructure called for were 20,000 cu.yd. of concrete, 1,200 tons of reinforcing steel and 1,200 M ft. b.m. of lumber for forms. Construction began June 15, 1925, and was completed May 1, 1926. The first concrete was poured June 23, 1925, and the last section of deck was poured Nov. 20, 1925. The contractor for the superstructure was the Turner Construction Co., Philadelphia and New York.

Concrete Strength Made Uniform by Careful Proportioning

Comparisons in a California Building Between Ordinary Volumetric Measurement, Weight Measurement and Inundation Method

By Zara Witkin,
Chief Engineer Herbert M. Baruch Corporation, Los Angeles, Calif.

On the Harris-Newmark Building, in Los Angeles, a reinforced-concrete loft of the limit height under the local building ordinances, an actual comparison of field methods of making concrete was made using first ordinary volumetric measurement of aggregates, then weight measurement of fine aggregate, and finally the inundation method of handling fine aggregate to secure uniformity. The results are shown in the accompanying diagram and as described hereinafter indicate a conformity of strength in the concrete with the increasing care with which the proportioning is done. The building, which was constructed by the Herbert M. Baruch Corporation, was described in *Engineering News-Record*, June 17, 1926, p. 982. In it a total yardage of concrete of approximately 14,000 cu.yd. was placed, which is sufficient, it is felt, to indicate a sound comparison of methods.

The concrete mixtures were specified by the architects, as follows:

> "All reinforced concrete and fireproofing used in the construction of this building shall be mixed of one part cement, 2½ parts sand and 3½ parts stone. All plain concrete shall be one part cement, 3 parts sand, 4½ parts stone. (Practically all concrete in the building was reinforced, therefore being 1:2½:3½ mix.)
>
> "Measurements of fine and coarse aggregates and of cement shall be of loose volume."

The provisions of the city building code require adherence to these theoretical mixes, and this is the reason for the specification.

From this it may be noted that there is no clause, either in the city code or in the concrete mixture specification, which defines the conditions under which the fine aggregate is to be measured except "by loose volume." The variation in fine aggregate and water content owing to "bulking action" of undetermined moisture in the fine aggregate are therefore not compensated for.

To meet this condition of concrete design, the first concrete placed was measured in ordinary volumetric hoppers, both the sand and the rock or gravel. While this served well enough for dry sand, neither the bulking action of the sand nor the moisture content of the sand or gravel was compensated for. The next step forward, therefore, was the weight-measuring hopper which attempted to correct by weight adjustment the volumetric variation in moist sand and the water content in coarse gravel aggregate, but these corrections were mere approximations and had to be guessed from average conditions. Finally, there was installed an inundator of the type devised by R. L. Bertin and manufactured by the Blaw-Knox Co., by means of which the moisture variations in the sand were taken care of by the complete inundation of all the sand before entering the mixer. The three types of measurement are noted on the accompanying diagram.

On practically every pour, at least two 7-day and two 28-day compression tests of concrete cylinders were made. Slump tests were made at the same time and a record was kept of the amount of cement used to produce the quantity of concrete placed, this amount being checked by such factors as the return of empty cement bags and the theoretical calculated yardage in various portions of the structure included in each pour as compared with the number and volume of the actual batches of concrete. The first concrete was poured on Sept. 3, 1925, and totaled 514 cu.yd. This concrete was placed in large combined footings in the foundations using a ¾-yd. mixer and proportioning the aggregates by volume. Successive yardages were poured ranging from 230 to 696 cu.yd. per pour until 3,059 cu.yd. were in place, the building then being at the first floor level. At this time, volume-measuring sand and rock hoppers were installed (Oct. 23) and a total of 1,621 yd. were placed using these batch hoppers. On Nov. 11 an inundator was installed and was kept in place during the remainder of the concrete work.

Analyses of Concrete Records—Three factors were observed under the various job conditions in the production of the concrete for this building—(1) the strength of concrete, (2) the amount of cement used per cubic yard of concrete mixed, and (3) the relation of slump to resultant strength. These are all indicated in the accompanying diagram.

In a rational process of construction, the problem would be to produce concrete most economically to meet required designed strength. Since, however, a definite mix is usually specified by municipal code and under job conditions, the resultant concrete may be of considerably greater or considerably less strength than the design contemplates owing to lack of accurate water-cement ratio control, and since further, owing to job conditions, the method of specifying a theoretical mix is inexact, allowing large measurement errors to enter owing to uncompensated bulking action of moist fine aggregate, then the problem becomes one of obtaining from a given, theoretically specified mix the highest strength and most uniform strength concrete at the lowest cost, this strength often exceeding the required designed strength and costing more proportionately.

Analysis of the concrete record curves will show that more cement was used in the mix before an inundator was installed than after, but the resultant concrete was on the average slightly less strong before accurate water content control and bulking action compensation were made, and the large, erratic variations with a few low margin strengths were to a great extent eliminated, the concrete strengths becoming consistently uniform when the water-cement ratio was controlled. In a word,

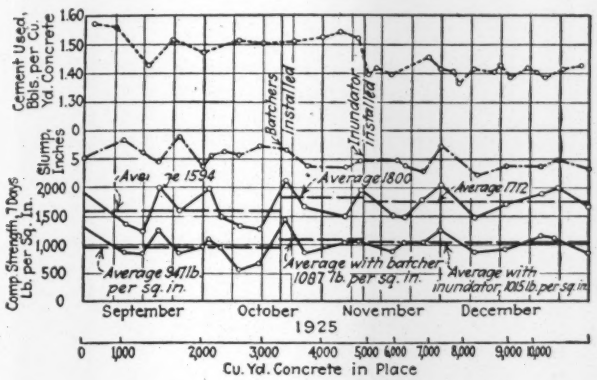


TABLE SHOWING RÉSUMÉ OF TEST GIVEN IN ABOVE DIAGRAM

Date Test Piece Taken	No. of Tests	Average Bbl. Cem. per Cu. Yd.	Compressive Strength, Lb., Sq. In. — 7 Days — Total	7 Days — Per Bbl. Cem.*	28 Days — Total	28 Days — Per Bbl. Cem.*
Aug. 28-Oct. 15	10	1.51	947	626	1,594	1,055
Batcher used.... Oct. 23-Nov. 9	4	1.53	1,087	710	1,800	1,180
Inundator used.. Nov. 11-Jan. 6	9	1.40	1,015	725	1,712	1,220

*This is obtained by dividing the actual breaking compressive strength by the average number of bbl. of cement used per cubic yard. It is merely an index of strength and not strength itself.

stronger, more uniform strength concrete was obtained at lower cost, and dangerous, low strength concrete was avoided.

Relation of Slump and Strength—The slump obtained by test of a given concrete mixture is, all other factors being constant, inversely proportional over a considerable range of values to the compressive strength at early periods. Varying degrees of fluidity of concrete mixtures are desirable for various elements of the work, a wetter mix being more easily conveyed to its position in chutes or in carts and poured in place and puddled. For filler walls, where high strength is of secondary importance and forms are narrow and deep, wet mixes are advantageous from a labor-economy standpoint and they safeguard against pocket and void formations in inaccessible corners of the forms and near closely placed webs of reinforcing steel. On the other hand, dry mixes attain high early strengths and allow faster assumption of load and removal of forms; consequently they facilitate prosecution of the work where speed is a desideratum.

For any given mixture there is an optimum quantity of water to be used which will produce a certain slump and which yields (other conditions being constant) maximum strength of the resultant concrete. We have, therefore, in the field, considerations which make it desirable to depart from the theoretically optimum water content in order to secure greater workability or faster hardening, but these departures in water content mean corresponding variations in the strength of the concrete.

The experience of the tests given herewith indicates, however, that, with the actual water content of the mix known and controllable, the mix may be varied to secure the desired workability of the concrete and the proportional changes in the strength of the resultant concrete may be calculated beforehand and predicted within a narrow range. Thus, a small and calculable-in-advance strength change can in some cases be allowed in order to gain a greater ease in placing large masses of concrete, and these values may be deliberately selected.

As is seen by inspection of the diagram, without the inundator, that is, without accurate control of the water content of the mix and consequently the erratic variations of the proportion of fine aggregate to the mix and the water-cement ratio, there is no relationship between the slump of the mixture and the strength of the resultant concrete. In order that the results be more effectively shown, the slump was plotted on an inverted scale and compared with the corresponding compressive strengths. The curves show that after the inundator was installed and in use, the slump being selected for desirable workability, the strength of the concrete varied inversely in proportion. The adherence to this law is rather strikingly shown by the similar shape of the curves when one is on an inverted scale on one co-ordinate axis, both being plotted to the same scale of time and yardage in place on the other axis.

Conclusions—From the observations on this building, the constructors draw the following empirical conclusions:

1. Variation in the water content of the fine aggregate under job conditions is sufficient to vitiate the proper water-cement ratio, and the strength of the resultant concrete, normally an inversed function of the slump, does not maintain this relation.

2. With accurate water-content control, using the same theoretical mix, the amount of cement per cubic yard of mixed concrete is decreased some 6 or 7 per cent.

3. With accurate water-content control and constant mix, strength is an inverse function of slump.

4. With accurate water-content control the strength of the resultant concrete with the same theoretical mix is slightly higher and considerably more uniform than under the conditions of ordinary guess mixing.

Cross-Connections Eliminated at Buffalo

A communication from the water commissioner of Buffalo to the State Health Department of New York reports that all cross-connections between the city water supply and questionable sources had been eliminated by July 1, in accordance with the resolution adopted by the New York State Public Health Council on Nov. 12, 1925, applicable throughout the state. Immediately on receipt of copies of the amended sanitary code containing the new regulations, the Buffalo water commissioner states, letters were sent to managers of plants where cross-connections had been found, enclosing a copy of the amendment to the code, and stating that on July 1 inspection would be made to see whether the amendment had been complied with. The commissioner states that in every case replies were received to the letters expressing a willingness to cooperate with the Bureau of Water in its attempt to enforce the provisions of the amendment to the sanitary code.

One of a Series of Articles on the Details of Design and Layout of Different Types of Industrial Buildings

A Cane-Sugar Mill and Plantation in Florida

Construction Required Clearing and Draining Jungle and Operation Involves Flood Protection —Rail and Water Transport—Crop Troubles—Mechanical Equipment and Processes Described

AMONG important industrial developments in Florida is the establishment of a cane-sugar plantation and mill for the Pennsylvania Sugar Co., some 18 miles west of Miami. Although the mill was built in 1922, its full operation has been delayed by floods and other conditions affecting the plantation. The company's property on which the plant is built consists of about fifty sections of jungle, where agricultural research has been carried on for six or seven years. Fig. 1 is a view of the sugar mill as completed in 1926, and Fig. 2 is a general plan.

There is no railway connection as yet, but a spur to a main line at Hialeah is expected to be built soon. At present freight is handled to and from Miami either by motor truck or by the company's barges and tugs operating on a drainage canal 75 ft. wide and having 4 to 6 ft. of water. About ten miles of standard-gage track serve the plantation and mill, the subgrade being a bed of limestone taken from the spoil bank of the canal and spread over the soft peat soil. This soil, 4 to 6 ft. deep, overlies a porous coral limestone. The plant railway equipment includes two gasoline locomotives and about a hundred 20-ton cane cars. These cars have hinged sides which facilitate unloading on a tilting platform or car dumper, the cane falling onto an apron conveyor.

Clearing and Drainage—In preparing the ground, the almost impenetrable growth of weeds and brush is leveled by means of tractors dragging a heavy rail between them. About sixty tractors have been employed on such work. In this condition the soil can be cleared either by burning or plowing, and if it is then vigorously worked it can be kept clear of weeds until the cane plants are large enough to crowd out other growth. If the soil is neglected after it has been plowed and fertilized and dried by the sun, a new growth of weeds arises with phenomenal speed and density so that the second clearing is more difficult than the first.

Besides clearing, drainage by means of ditches is required, and about ten miles of such ditches have been excavated by means of a floating dredge with 1½-yd. bucket and several gasoline dipper dredges mounted on crawler tractors. With all of this tractor and excavator equipment it has been possible to prepare only about 5,000 acres of jungle in six years.

Several times a satisfactory crop of cane in prospect was destroyed by floods due to rains and the overflowing of Lake Okeechobee. The fall toward the sea is so small that the movement of the water is sluggish and in the absence of sufficient trunk drainage canals the water is backed up 2 ft. deep over the fields and keeps them inundated for two or three months. Such floods did not occur during the three-year period of cane planting preceding the construction of the sugar factory; nor were these floods expected, as there were no records available from the U. S. Weather Bureau, which had not then established a station in Miami.

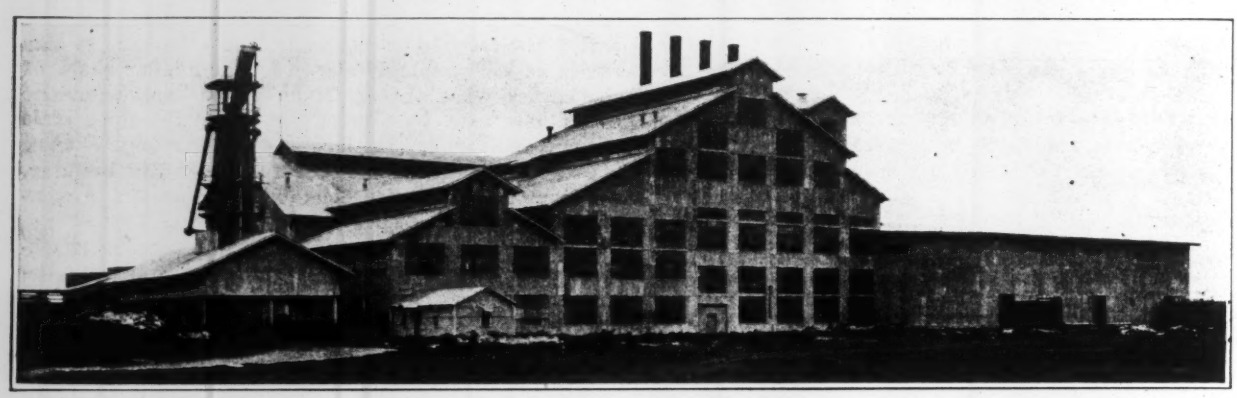


FIG. 1—SUGAR MILL AT MIAMI, FLORIDA
Cane conveyor and limekiln at left. Main mill building in center and warehouse at right.

Drainage of the Everglades by the state has not been completed, so that in the autumn of 1925 the floods from Lake Okeechobee, combined with heavy rains, kept the fields inundated, retarding the cane crop and causing serious loss. The company thereafter built a levee around an experimental field of 4,500 acres and installed a pumping plant which discharges the seepage and rain water into the state canal. During floods, the location of this canal can be recognized only by the line of levee and spoil bank.

This 4,500-acre field is drained by numerous lateral canals leading into a main canal 20 ft. wide and about 6 ft. deep at the lower end, where it terminates at a pumping station. Three vertical-shaft centrifugal pumps with 54-in. suctions are rope-driven from three 125-hp. semi-Diesel oil engines. Each pump is designed to deliver a maximum of 75,000 g.p.m. to a height of 4 ft. The pumps have no volutes but are projected through circular holes in a reinforced-concrete floor which spans the lateral canal. This canal is dug 4 or 5 ft. through the top soil and an equal distance into the

porous limestone below, and is the same depth as the state canal into which it drains.

The top of the concrete pump floor is a foot above the limestone ledge and by means of the gates the pumps can direct the water either from the lateral to the main canal or into the laterals for irrigation. One year there was a lack of moisture at a time when California smudge pots. Some of the earliest plantings survived the frost and it was thought that the young plants which appeared above the surface could be saved by cutting them off at the ground line, as it was found that when this was done, the plants continued to grow without any apparent loss of time or quality. An unexpected advantage of the land drainage was that this

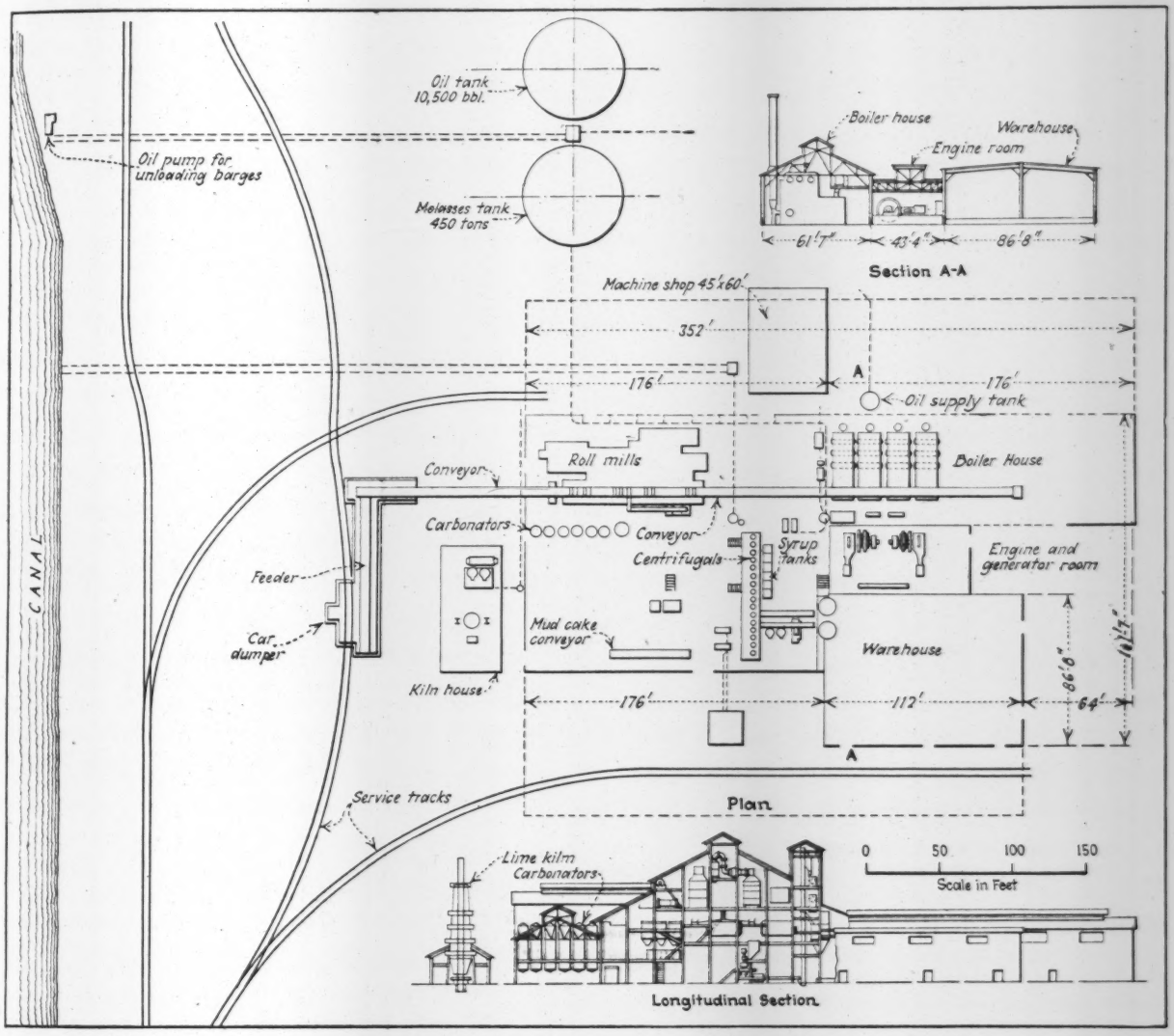


FIG. 2—GENERAL PLAN OF SUGAR PLANT NEAR MIAMI, FLORIDA

the cane was urgently in need of it. In anticipation of such an emergency, the gates have been arranged so that water can now be pumped either out of or into the canals serving the enclosed field. A similar arrangement for a rice plantation in Louisiana was noted in *Engineering News-Record* of Nov. 2, 1922, p. 741.

As the cane crop in 1925 was severely injured by the spring flood, the company planted 3,000 acres to potatoes, importing the seed from Maine. In 1924, a 200-acre patch yielded a good cane crop which was delivered to the company's mill at Philadelphia in less than three months after the planting. In January, 1925, the crop looked promising, but later a heavy frost did considerable damage, notwithstanding the use of 12,000 destructive frost did not occur for a width of about 800 ft. along the leeward side of the canal. It is planned to increase this protection, therefore, by cutting ditches and canals through all the cane fields in order to counteract the frosts.

Sugar Mill—The plant, Figs. 1 and 2, consists of the milling house, boiler house, power house and boiling house, all the buildings being of steel and concrete, with walls of corrugated steel and steel sash. It is designed for an ultimate capacity of handling 1,500 tons of cane daily, but is reduced to a temporary capacity of 1,000 tons by the omission of some equipment.

The milling house, shown in Fig. 3, contains a 33x 78-in. two-roll crusher, a shredder and a nine-roller

34x78-in. crushing mill. The cane is fed to this machinery by an apron conveyor receiving its load from the plantation cars already mentioned. The refuse pressed cane, or bagasse, containing 45 to 50 per cent moisture, is carried by a similar conveyor to the oven furnaces of four water-tube boilers of 500 hp. These furnaces are fitted with auxiliary oil burners to supplement the bagasse when necessary in order to maintain the 150 lb. pressure. The boilers supply two 875 kva. low-speed corliss engine generator sets which produce power for driving machinery and low-pressure steam at 10 to 15 lb. for the heating and evaporating processes. Most of

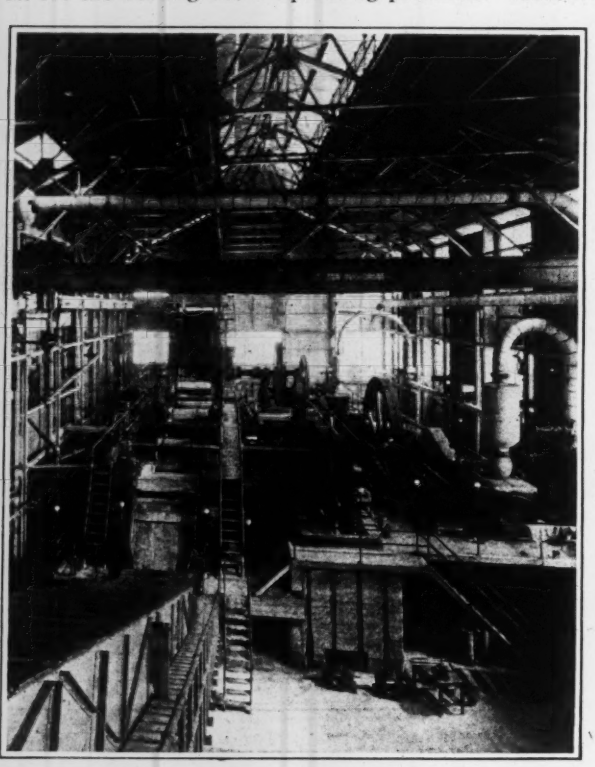


FIG. 3—CANE CRUSHER AND ROLLS
Cane delivered by conveyor in rear wall goes to crushing rolls and then to pressing rolls. The refuse cane or bagasse is carried by the apron conveyor (left) to the boiler house.

the pumps are electrically driven centrifugal pumps, with a few geared plunger pumps for heavy liquors. Only the drip and feed pumps and the automatic oil pumping set are operated by steam. All mill machinery equipment is electrically operated, except that the crusher and the roller mill are geared to corliss engines.

Sugar Manufacture—In the three-story boiling house, Fig. 2, the top floor contains the heaters, evaporators and vacuum pans. On the second floor are the crystallizers, filter presses, defecators, carbonators and other clarifying equipment. On the ground floor are the centrifugals which separate the moisture from the finished sugar; also the pumps and the packing equipment. This plant is equipped for the direct production of white sugar.

The juice expressed in the roll mill is screened and pumped to tanks on the top floor, where it is weighed and sent to tanks in which a stream of lime milk is added to neutralize the organic acids. This juice is then heated and fed to carbonators in which the lime is precipitated by the addition of carbonic acid gas. The lime and carbonic acid gas are both produced in a vertical lime-kiln which has automatic apparatus for discharging the burned lime at any desired speed into the slacking chamber from which the lime milk is pumped to the mixing tanks. After passing through a defecator or purifier and scum tanks the treated juice is pumped through filter presses and the carbonation process is repeated in order to produce a clear and sparkling liquor, which is then bleached in a sulphur chamber.

For concentrating this sugar liquor, it is passed through a quadruple-effect evaporator, with exhaust steam applied to the first chamber and with a higher vacuum in each successive chamber. Liquor is fed continuously to the first chamber and the thick syrup, containing about 50 per cent sugar, is drawn off from the last chamber. This syrup is then boiled in vacuum pans until it crystallizes. Then the crystals are separated from the moisture or molasses in centrifugal separators and are dried in a pair of rotary cylindrical driers, after which the product goes to the packing machines. Horizontal spiral conveyors and vertical belt-bucket conveyors handle the sugar between processes.

Design and Construction—This plant, owned by the Pennsylvania Sugar Co., Philadelphia, Pa., was designed and built by the company's engineering department, under the direction of Dan Gutleben, chief engineer. W. H. Hoodless is general manager; E. R. Graham is resident manager at Miami. When the steel frame for the plant had been erected and the installation of the equipment was proceeding, in the fall of 1922, continued heavy rains flooded the entire factory site to a depth of about 18 in. Construction work continued within the building, although the water was 6½ ft. deep, as the soft peat soil had been stripped 5 ft. deep to the level of the prevailing limestone. Equipment brought by barges through the canal from Miami was ordinarily handled over the company's ten miles of standard-gage industrial railway, but during this period of inundation, tanks and crystallizers were pushed off the barges about 1,000 ft. from the factory site and were floated to within reach of the erector's rigging.

Limit Gaging and Fits Standardized by A.E.S.C.

A system of limit gaging and a comprehensive scheme of fits for machine parts has been developed and adopted by the American Engineering Standards Committee. This action, according to the annual report of the committee, just issued, "lays the basis for the carrying out of complete interchangeable manufacture on a national scale, as well as for facilitating mass production within the individual factory." The ultimate economies realizable through the use of the system are expected to be very great. One of the important projects now being dealt with by the committee is the standardization of drafting room practice. A committee is shortly to be organized also to standardize methods of graphically presenting facts. A great deal of work is in progress on industrial safety codes, among which several were completed and approved during the past year, including codes for paper and pulp mills, elevators and escalators, and a gas safety code. A similar piece of work in the mining field was the completion of a code for rock dusting of coal mines. A safety code for aeronautics, dealing with standards of safety for design, construction, testing and operating of aircraft, has also been developed and complete national agreement reached upon it.

Welded Steel Members and Joints Tested at Pittsburgh

Built Girders and Structural Connections Tested to Failure—Welds Able to Develop Full Strength of Steel

ONE of the most extensive sets of tests on welded structural steel work yet carried out was made at Carnegie Institute of Technology last week for the Westinghouse Electric & Mfg. Co. Its purpose was to determine whether the various types of connections required in the frames of buildings can be made satisfactorily by arc welding. Some twenty specimens representing typical connections or forms of member were tested to failure in the 400,000-lb. testing machine of the Institute laboratory.

The results were excellent; in every case the welded connection developed the full strength of the member, and while in three instances failure occurred at the weld, even here the ultimate load corresponded closely with the full strength of the connected parts. The elastic behavior of the members was satisfactory in all cases.

Some riveted members and connections were tested, to establish a basis of comparison for the results obtained in the welded tests. The riveted members gave satisfactory strength results and excellent elastic behavior, but they were surpassed in strength by the competitive welded connections. Most interesting of these were tests of five plate girders, two riveted and three welded, noted first in the following summary of the results.

Plate-Girder Tests—Four plate-girders were tested, two riveted and two welded; of the latter, one was of typical construction with two-angle flanges, while the other had plate flanges welded to the web plate by continuous beads at the inner corners, and stiffeners made of flat bars set at right angles to web and flanges and welded to them. This girder also was of larger cross-section than the others, having a cover-plate welded over the middle part of the top flange. It was of the same weight as the riveted girders, and was intended to show that the metal saved by welded connection can be used to increase the strength of a member. All four girders were 14 in. deep over the web plate, or 14¾ in. over flanges, and 15 ft. long, being tested on a 14-ft. span on rocker supports with downward load applied at the middle by the movable head of the testing machine.

Failure occurred in all cases by buckling of the top flange, either side of the load close to the center. All

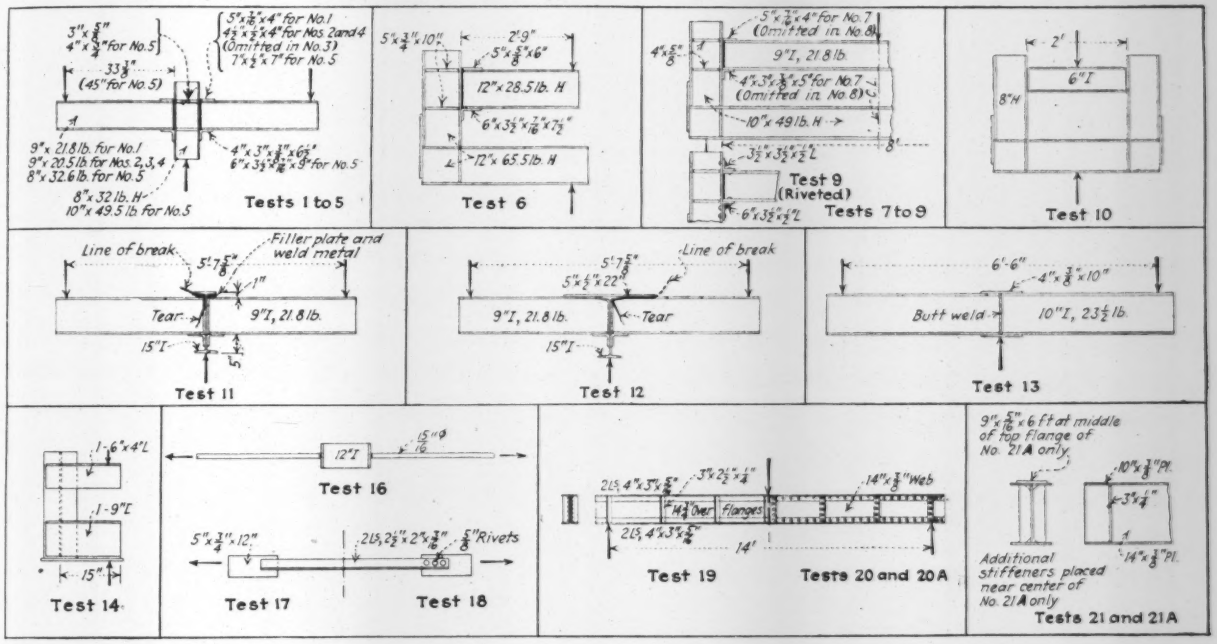


FIG. 1—SKETCHES OF SPECIMENS IN PITTSBURGH TESTS OF WELDED MEMBERS

The four specimens reached their elastic limit at about the same load, but the welded specimen reached a higher maximum load, apparently because of more rigid connection of web and flanges by the welding as compared with riveting, and in the case of specimen 21A, because of the extra strength and stiffness due to the cover-plate of the top flange. The test results are given in the table below:

	Riveted		Welded Angle	Welded Plate
Test number	20	20A	19	21A
Weight, lb.	798	798	785	795
Load, lb.				
Elastic limit	55,000	55,000	65,000	60,000
Maximum	68,900	75,800	77,200	110,350
Flange stress, lb. per sq.in.				
Maximum	47,400	51,000	53,800	69,300t / 49,000c

Load-deflection curves for the four tests are shown grouped together in Fig. 2.

Tension Connections—A two-angle tension member was tested in two specimens, with riveted and welded gusset-plate end connections respectively (17 and 18, Fig. 1). The test results are plotted by load-elongation

curves at the right in Fig. 2. It will be seen that elastic failure occurred at about the same load in both, but that the welded member reached a higher maximum load because it was not weakened by the rivet holes. The respective maximum loads were 72,000 and 94,000 lb. for the riveted and welded member respectively, representing fiber stresses of 53,000 lb. per sq.in. (net section) and 58,000 respectively. The riveted member broke through the first rivet-hole of the end connection, while the welded member broke at the front of one connection plate, at a point where the crater of the weld had not been filled up and the section thus was slightly reduced. Both specimens had excellent silky fracture, with 45-deg. shear failure.

Another tension connection, of special kind (16, Fig. 1) was tested to determine the feasibility of attaching a hanger rod to the flange of a beam by welding, as might be required in the case of a balcony hanger. The connection was made by beveling the ends of the two rods, welding to fill this space and forming a substantial collar around the connection by a bead around the rod. Elastic failure occurred at a load of 23,200 lb., while at 35,000 lb. the bar broke about halfway between the beam and one set of grips. A duplicate specimen failed in the same way, both breaks being normal tension failures with deep cupping and heavy necking. The test indicated that neither the weld nor the immediately adjacent part of the rod constituted a weak spot in the composite tension member.

Butt-Welded Beam—A 10-in. I-beam 7 ft. long, cut at the center and joined by butt welding, supplemented by a 4 by $\frac{3}{8}$-in. cover splice plate 10 in. long on either flange (13, Fig. 1), was tested as a simple beam. Elastic failure and maximum load occurred at 55,000 and 72,900 lb. load respectively, the maximum flange stress being 62,000 lb. per sq.in. The weld was undamaged, and the beam failed by twisting of the load at one end, though the flange stress represents the full capacity of the material.

Beam-Column Connections—A number of forms of connections of beams to columns were tested, some mainly with reference to shearing strength, others for bending strength.

As a measure of shearing strength, a 6-in. standard I-beam 2 ft. long, welded between two 8-in. H-columns (10, Fig. 1), was put under central load. The beam was bent down by the web crippling at a load of 83,000 lb., but the weld held.

To give a measure of bending resistance of similar connections, three specimens having 9-in. beams welded or riveted between 9-in. H-columns, span 8 ft., were tested under central load (7 to 9, Fig. 1). All three specimens failed by crushing down and twisting sideways in the middle, without failure of the riveted or welded attachments to the column. The respective maximum loads were 58,700 for the riveted beam, and 67,200 and 73,750 lb. for the two welded beams. The weaker of the two welded beams did not have a seat angle or top splice plate at the connection of beam to column. Absence of these connections did not lead to failure of the weld, but apparently made the connection less stiff at right angles to the web of the beam, thus permitting earlier twisting of the web. Assuming test 7 to represent complete end fixation, the degree of fixation in the two other tests was 84 per cent for the weaker welded beam and 60 per cent for the riveted beam.

A similar connection of a 12-in. beam connected to a 12-in. column, tested under cantilever loading (6, Fig. 1), failed similarly by twisting of the beam at 47,000 lb. load, the column also receiving a severe bend during the test.

Similar connections were tested in another form, having two short lengths of beam attached on opposite faces of a column stub (1 to 5, Fig. 1). This group of specimens included several variations in detail, as indicated. Test 1 had a yield-point load (load on column) of 55,000 lb., and reached its ultimate at 75,100, at

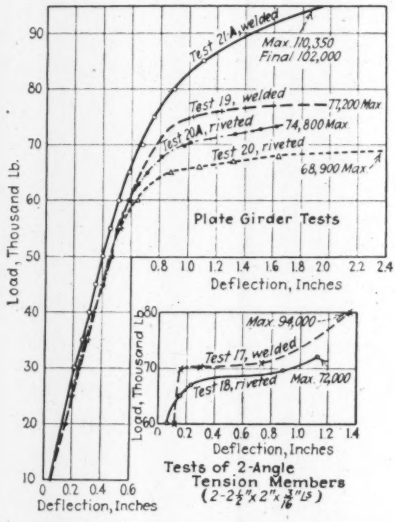


FIG. 2—TYPICAL LOAD-DEFORMATION CURVES

which time the welded attachment of one cover plate to the beam flange was partly cracked loose, although failure occurred by twisting of the end of one of the beams. Test 2, detailed with narrow top cover plate and wide seat angle, to permit downward welding in both cases, also failed by twisting of the end of one beam, but without injury to the weld, at 70,000 lb. maximum load. The same type of failure, and only slightly lower maximum load (68,550 lb.) was reached in test 3, where seat angles and cover plates were omitted, and the beams were directly butt-welded to the face of the column. In test 4, using seat angles and cover plates, but omitting the diaphragm plates between column flanges, failure occurred at relatively low load (53,400 lb.) and the column web buckled opposite the compression flange of the beam. Test 5, with heavier details, failed at 80,000 lb. load by breaking through the welded connection of cover plate and beam flange to the column flange, tearing down through the web of the beam from this point, and at the same time buckling the opposite flange of the same beam.

Beam-Girder Connections—Two test pieces similar to the preceding, but with the beams attached to the web of a 15-in. girder instead of to the face of a column, were tested in similar manner (11 and 12, Fig. 1). The second of the two specimens had the beams flush with the top flange of the girder and connected across the girder flange by a 5 x $\frac{1}{2}$-in. splice plate 22 in. long. The two specimens failed at 64,000 and 94,000 lb. load respectively, after passing elastic failure at approximately 52,000 and 60,000 lb. load respectively. In both cases fracture occurred through the top flange connection and

extended thence down through the face weld and the web of the beam, partly as a tear. While the ultimate load values reached were high, the welded joints between beam and girder flange in the first specimen, which contained a small filler plate and weld metal connecting this plate to the two flanges, appeared to be imperfectly welded, while in the second case the welds between cover plate and beam flange were overhead welds, which possibly contributed to locating failure here. The calculated stresses at midspan, ignoring the reinforcement here, were 57,300 lb. per sq.in. and 84,000 lb. per sq.in. respectively.

Column Brackets—In test 14 the welded connection of a 6 x 4-in. angle bracket to the flange of an 8-in. column was tested, leading to early failure by bending of the angle and column, without damage to the weld.

The test specimens were designed by Gilbert D. Fish, consulting structural steel engineer for the Westinghouse company. The series of tests was initiated by W. S. Rugg, vice-president in charge of engineering. All material for the test specimens was contributed by the American Bridge Co., which also furnished the riveted specimens complete.

Some Possibilities and Problems in Structural Welding

By James H. Edwards
Assistant Chief Engineer, American Bridge Co., New York

(Extracts from a discussion before the Structural Division of the American Society of Civil Engineers, July 14.)

WELDING of structural steel is naturally looked upon with suspicion by structural engineers, not because their experience would lead them to mistrust the results of the modern methods but because of a tradition handed down from the time when steel took the place of wrought iron as a structural material.

In the early days of structural steel manufacture, when the material was not as uniform as present-day standard specification steel, and when welds were made by the blacksmith method using forge furnace and hammer, some unfortunate results were obtained. The early specifications for steel structures practically prohibited the use of welding or reduced the unit values so low that it was not considered possible to make safe and economical joints under the circumstances.

The welding art of the present day is beyond the experimental stage, and if welds are designed by those who know the safe limits under the various conditions, and welding done by trained workmen, satisfactory joints can be made. Structural engineers should welcome any method that leads to economic progress; on the other hand when human life is in jeopardy they should satisfy themselves that under ordinary facilities of execution their structure will be safe.

In connection with city buildings, there are outstanding reasons for the careful consideration of welding of field joints. One is the elimination of the noise of riveting in thickly settled communities, even at a greater cost; another, somewhat connected with it, is the possibility of making welded connections for resisting lateral forces, such as wind, much simpler than the present cumbersome riveted brackets that interfere with the architectural treatment of exterior walls and interior finish.

It would seem possible to apply a combination of the old and the new methods in the erection of our multiple-story or tier buildings, by making use of sufficient bolts to hold the skeleton frame in position and then follow with welding to obtain the required strength and stiffness at the joints. Such a procedure would largely do away with objectionable noise.

Welding could advantageously be used for shop fabrication where the preparation of materials and the welding operation would be under conditions insuring definite procedure control. Welding in the field, considering the demands as to time of completion to fit in with other trades, the training and experience of field erectors, and the cost, would lead to slower adaptation. Because of the liability of indifferent execution under unhandy conditions, as in the case of the hand method of driving rivets, field welding demands more cautious study.

As the art of welding becomes more used, shapes more economical and better adapted to the welding process will be furnished, and component parts of a structure will be changed to better suit the method of making joints by welding.

When it is possible to make welded joints of about the same strength of the parent material, the whole gross area of the metal is available for stress. There is no loss such as deduction for rivet holes, and furthermore, because of the possibility of making joints practically fixed ends, supporting members in flexure can be figured as continuous, and also compression members due to fixed end conditions will carry greater safe loads, thereby reducing the amount of material required.

The structural industry before it can intelligently adopt welding wants the fundamental units that can be applied in designing joints. It can then determine the proper strength for joints made in ordinary structural steel when any of the various processes of welding are used.

In a recent paper (Journal American Welding Society, May, 1926) the writer outlined some of the outstanding features that should be determined:

(A) Can standard structural steel be satisfactorily welded and what are its limitations? If this grade of material is not suitable, what is?

(B) What effect will the welding process have on the parent or main material?

(C) Standard methods of making welds by different processes should be determined. Values on some unit basis for the strength of welds of different types should be fixed.

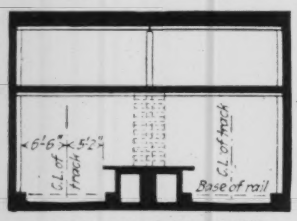
(D) Some reliable way of controlling the mechanical and personal element in the making of welds and in testing the completed work should be established.

With this information fixed by scientific research and available to the industry, the manufacturers of welding apparatus, the advocates of welding as a method of joining steel parts, and the fabricators of structural steel, all co-operating to solve an engineering and economic problem, will make progress.

The American Welding Society, realizing the need of scientific research to determine fundamental safe units, has organized a committee to undertake and direct such work, and would welcome the help and guidance of structural engineers interested in this development.

Proposed Rapid-Transit System With Continuous Platforms

BASING on a study of how maximum passenger capacity of rapid-transit railways may be developed, a New York engineer, Philip Sachs, has recently proposed a modified type of rapid-transit subway, differing from the conventional types in construction and in method of operation. His proposals are given in full in a paper read before the Municipal Engineer Society of New York. The essential feature of his structure is a continuous center platform between tracks. By this expedient, with auxiliary features of construction and operation, he claims, a two-track line can be made to carry a traffic volume as great as or greater than the maximum capacity of existing four-track lines operating local and express service, while at the same time giving a transit speed equal to that reached by present-day express service. The line would cost little more than two-track lines at present, and would occupy no greater ground space.



CENTER-PLATFORM SUBWAY STRUCTURE

One form of a proposed new type of rapid transit subway

In the adjoining sketch a section of one form of the proposed type of structure is shown. The tracks are spread sufficiently to accommodate between them a platform 12 ft. wide, extending continuously along the entire line and connected at intervals with mezzanine platforms above by means of stairways. Trains would stop at fixed points, spaced about as present local stations, say 1,500 to 2,000 ft. apart, at which points also the mezzanine platforms would be located, with stairway connection to the street surface. The mezzanine floor where stations are close together might also be made continuous.

Trains operating on such a railway would not have a maximum length fixed by the station platform length as at present, but could be of any length required by the traffic volume. Because of this feature, the type of structure proposed would be flexible in operation and could develop a train capacity limited only by track conditions.

The author's proposals include alternate-station operation as an essential auxiliary, with a view to permitting closer train spacing as well as higher average speed. The passenger would then have the speed advantage of a service with long station spacing—3,000 to 4,000 ft.—and the convenience of a service with half that station spacing. The method of operation would be such that one train, *A*, would stop at the first, third, fifth, etc., stations, while the next or *B* train would stop at the second, fourth, and sixth. The entire train schedule would consist of a succession of *A* and *B* trains. Proper block signaling would make this system quite as safe as the ordinary or every-station system of operation.

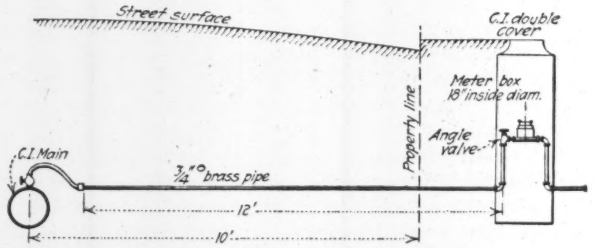
One traffic advantage of the proposed system is that the heavy interchange between express and local trains now occurring at times of rush-hour traffic would be both reduced and distributed. Such interchange increases the length of time a train is held at a station and thereby cuts down the train and passenger capacity of the line. Further, the difference in schedule speed between express and local trains has the effect that the local tracks now serve mainly as feeders to the express trains, the result being that the real through capacity of a four-track local and express line is not much in excess of two tracks, or, as Mr. Sachs claims, only just equal to two-track capacity in view of the abnormal duration of the express-train stop. Under his system all trains would make an express-train schedule speed, and full track capacity corresponding to the operated length of train could be realized.

With reference to the size of structure and amount of space required, it is claimed that the overall width of the proposed two-track structure is practically the same as the mean width of conventional two-track line whose local station platforms occupy about one-fourth the line length, as is usual today. Accordingly, the cost of the structure should not be materially greater. On this bases it is urged that present rapid-transit construction costs can be reduced by half, since two tracks would perform the service of four tracks of the present systems.

A number of variations in the construction are suggested in the original paper to suit especially narrow streets, to provide a combined local and express service on four tracks, and the like.

Water Service Connections and Meter Rules at Venice, Neb.

THE water supply for the summer resort on the Platte River, known as Venice, Neb., is owned and operated by the Martin & Heyn Co., with headquarters in Omaha. As water is taken only a few months in the year rates are adjusted accordingly. All water is sold by meter measurement. The first cost of services and meters, including material and labor, is borne by the consumer. All the material and labor required from the main to a point 18 in. beyond the meter is supplied by the company and charged to the consumer at the uniform rate of $42.50, which the consumer or his plumber pays in advance. The remainder of the material is supplied and labor performed by the plumber, but not until he has obtained a permit from the company, which covers also construction of interior pipe and fittings.



SKETCH OF WATER SERVICE CONNECTION AND METER, VENICE, NEB.

A sketch of a typical installation of a service connection and meter is shown herewith. The cast-iron double cover to the meter box was designed by the company. Its principal features are a 12-in. open space for frost protection and a special lock.

A section of the regulations governing material for

the service pipe from the meter to and into the building supplied and certain related matters reads:

Connection to meter, not less than 18 in. of ¾-in. XX lead pipe with lead flange connection. Thence with either ¾-n. galvanized-iron, brass copper or XX lead pipe to riser inside building wall. At this point a ¾-in. inverted stop and waste cock shall be installed of Crane or Mueller or equal make. Service pipe shall be installed not less than 42 in. nor more than 6 ft. below the surface of the ground, and stop and waste cock shall be 1 ft. inside inner frame of outer wall of building and 42 in. below surface of ground. Stop and waste cock shall be equipped with extension key extending above floor of building or below floor of building in such a manner as to be accessible through a small trap door. No other pipe or conduit will be permitted to be laid in same trench as water pipe.

All consumers pay a flat charge of $6 a year paid in advance on the first day of May; and in addition 20c. per 1,000 gal. of water consumed less 5 per cent if bill is paid within ten days of its date. Meters are read at approximately monthly intervals.

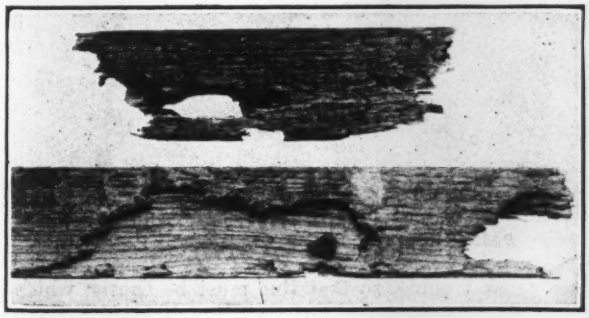
We are indebted to Mark Martin, president of the Martin & Heyn Co., for the information given.

How Flying Ants Damage Buildings; Their Elimination

Entomologist Suggests Simple Building Ordinance Changes to Eliminate Any Contact of Untreated Wood and Earth

OWING to lack of information on the destructiveness of our native termites or white ants and their wide distribution throughout the United States, buildings are often erected with untreated woodwork directly in contact with the ground, leaving the way open for the entrance of these insects. In consequence termites burrow into the wood and may greatly damage the building before their presence is detected.

Depredations of termites (white ants) last year closed St. Boniface's Catholic Church, Edwardsville, Ill.,



OAK FLOORING EATEN UP BY TERMITES IN OHIO

and pillars and beams supporting the roof had to be rebuilt. The structure, of brick, was erected in 1869. Herman von Schrenck, consulting engineer, St. Louis, states that every spring so many cases like this occur that his office is besieged with requests for assistance. In the church case, it was discovered that the ants had gnawed the inside of four large carved wood pillars supporting the roof of the church, leaving mere shells. Each pillar carried a mean roof load of 1,600 lb., and engineers considered it remarkable that the roof did not collapse. Fortunately, no heavy snows fell during the winter, which probably accounted for the roof holding up.

The only effective permanent preventive and remedy, according to T. E. Snyder, of the Bureau of Entomology, United States Department of Agriculture, who has written *Bulletin* 1037 on white ants, is proper construction of the building with regard to knowledge of the habits of termites and the specific that will eliminate them. This specific is "insulation" of all untreated woodwork from contact with the ground; it can be accomplished by the use of stone or concrete foundations and lower flooring or the use of foundation timbers impregnated with coal-tar creosote. Practically all the termites which damage buildings in the United States are of subterranean habit; if they can be kept from reaching woodwork from the ground they can not survive in the building. Also, if present in a building, after all untreated wood, such as joists, wooden floors, sills, etc., has been removed from contact with the ground, they will die out, i.e., dry up; even if the termites have penetrated to the height of several stories in the building. They have been cut off from their moisture supply which they derive from the ground and which is necessary for their life.

WORKER TERMITES OR FLYING ANTS

Recently the Bureau of Entomology has been advocating the modification of the building regulations of various cities so as to include the following simple rules to prevent attack by these insects: No floors, sills, beams, clapboards, etc., of untreated wood should be laid on or in the earth. No lime mortar should be used in foundations or in cellar walls where they are in contact with the earth, since termites are able to penetrate lime mortar after some years' service. All brickwork extending below the surface of the ground should be faced and capped with concrete at least 1 in. thick. These slight modifications of the building regulations of cities by city engineers would save much property.

The recommendation of the use of heat, steam, insecticides, and fumigants against these subterranean termites is of no permanent value and is futile. If conditions in a building are unsuitable to termites they will leave; if they can be prevented from leaving or coming in again by shutting them off from the ground, nothing further need be done and anything else is only a waste of time and money. Complete insulation of all untreated woodwork from the ground is the only effective method of preventing the ravages of termites in buildings in the United States.

The termite problem is of vital importance in the tropics and in the interest of pushing the use of preservatives the Department is building a model demonstration termite-proof building at Ancon, C. Z., of treated wood and fiber board. Sills, sub-floor and joists will get a full-cell pressure creosote treatment. Studs, headers, plates, ceiling joists and rafters will have empty-cell pressure treatment of creosote. Zinc chloride will be used for the floors, siding, shingle strips, window and door frames and sash. The building will stand on concrete posts 3 ft. above ground.

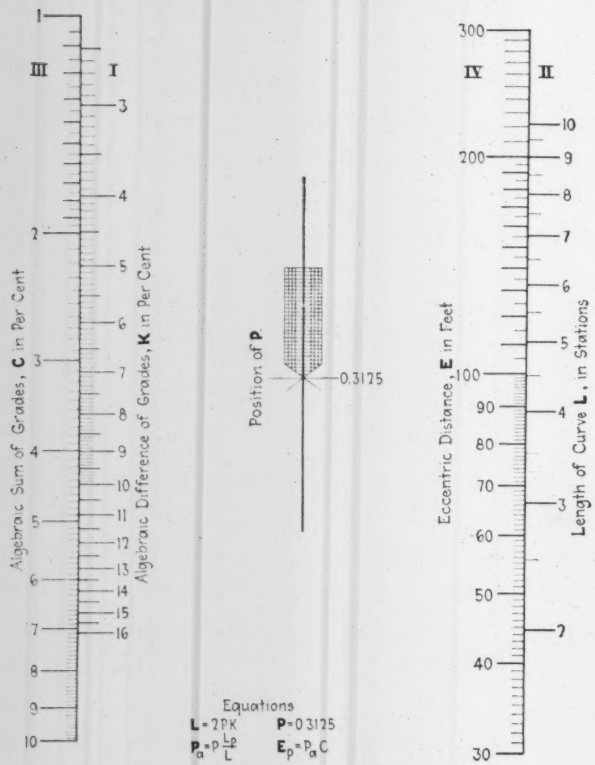
From Job and Office

HINTS THAT CUT COST AND TIME FOR THE CONTRACTOR AND ENGINEER

Alignment Diagram for Vertical Curve

By M. W. Furr
Associate Professor of Civil Engineering, State Agricultural College, Manhattan, Kansas

THE alignment diagram shown below is of interest in connection with the solution of the parabolic curve for highway grades to insure 500-ft. clear vision,



VERTICAL CURVE ALIGNMENT CHART

as presented by the writer in *Engineering News-Record*, May 20, 1926, p. 819. The equations are arranged as follows, as a basis for the diagram:

$$L = 2PK, \text{ where } P = 0.3125$$

or $$L_p = 2P_aK$$

and $$P_aL = PL_p$$

Furthermore, $E_p = P_aC$.

Example: With $K = 11$, as given; (1) center the isopleth on the theoretic value of P, on the pivot scale, and also on 11 of Scale I; read 6.87 for L on Scale II; change L to read 7, using Scale I as the hinge, and observe the falling of the isopleth on the grid of the pivot scale; (2) enter Scale III with the given value of $C = 2.50$; with the isopleth at the altered position of P on the grid and reading 2.50 of Scale III, the value of E_p is found directly on Scale IV to be 80 ft.

In case C is less than unity, use Scales III and IV as above, and place the decimal point accordingly.

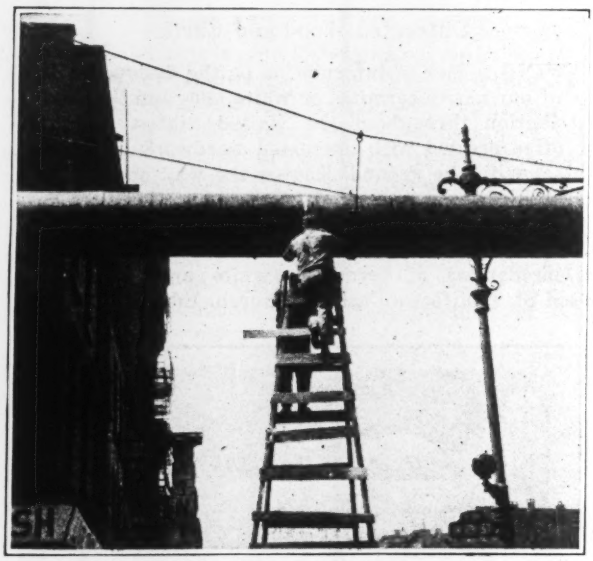
Survey Details in Subway Base Line Work

By C. J. Brady
Junior Engineer, Board of Transportation, New York City

SURVEYS for any large construction job are usually accepted as a matter of course, though often difficulties arise commensurate with those encountered in doing the work itself. In the construction of the Eighth Ave. subway, New York City, for instance, instrumental work involved greatest precision in base-line control.

In establishing the base line, we first try to spot a location which will be of the most service. It would be a waste of time and labor to lay out a line visible for only a few hundred feet, when it might be possible to secure one of two or three thousand feet. Beyond this length, however, refraction must be considered, so it is not good policy to use sights farther away than 3,000 ft.

When establishing the base line signs and street show-



PAINTING LINE SIGHT ON BYPASS PIPE

cases cause trouble, so that line must be chosen which is far enough from the building line to escape these obstructions, but not so far that the line will be thrown beyond the curb. Difficulties imposed by traffic and irregularities in contour are overcome by bridging with high sights set on tripods.

Between 14th St. and 59th St., Eighth Ave. is practically straight. In this stretch it is necessary only to lay off equal distances perpendicular to the street center line at both ends of this tangent to clear all obstructions. With the transit set on one end, and the sight on the other, the line is tried out as to the buildings between the two ends of the tangent. That base line is finally accepted which is of the shortest

mean distance from the buildings approximately parallel to the base line which are tried out.

In running this tangent line we set a high sight at one end and run toward it. Instrumental work has been greatly facilitated by the ability to make use of bypass overhead pipes for back- and fore-sights. The accompanying photograph shows one of these sights being painted on the pipe. As we move along the base line we record building positions and leave line "cuts" at convenient distances, usually 200 ft. apart, or at the intersection of side street building lines. These line cuts are used later in stationing the base line, and also as transit stations as we proceed toward the end of the tangent.

The actual instrumental work is very carefully executed. The line is kept straight by double centering several times. A further check is the reading of the angle at a transit station and two line points. Several angles are read by repetition, and the final angle must be 180 deg. If it is not, a correction in the line is made, and the process repeated. The repetition method is also used where there are bends in the base line, with the additional precaution that 360 deg. of arc are completed.

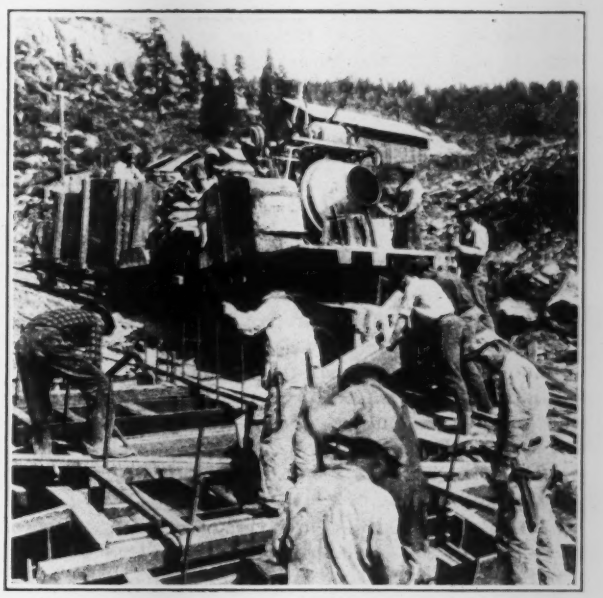
Greatest care and refinement of measurement of the base line are used. Base line stations are established every hundred feet by means of a standardized steel tape and compensating balance. In our work along Eighth Ave. we have laid out the line with a 100-ft. tape, and checked it with a 50-ft. tape. A bubble attachment on the thermometer shows when the tape is level; graduations on the balance make the necessary correction for temperature, and the pull on the balance spring takes up the sag and indicates the proper pull. As construction begins the base line is gradually transferred into the cut or tunnel, as the case may be, and the same precautions are used below the surface as were originally employed on the surface.

Penstock Anchors Poured from Mixer on Incline Car

CONCRETE anchors and saddles on the Balch project of the San Joaquin Light & Power Corporation in California are being poured from a portable mixing plant mounted on cars that move up and down the incline alongside the penstocks. The materials plant is at the top of the incline and the work is advanced from the top downward. Nine anchors and 100 saddles are being poured with this rig, totaling about 2,200 cu.yd. of concrete.

The rig consists of two separate cars each having a steel frame with a wheelbase about 12 ft. long. The two cars can be connected and hoisted as a single unit, or the mixer car can be fastened to the track while the car containing aggregate bunkers is hoisted for a new supply of materials.

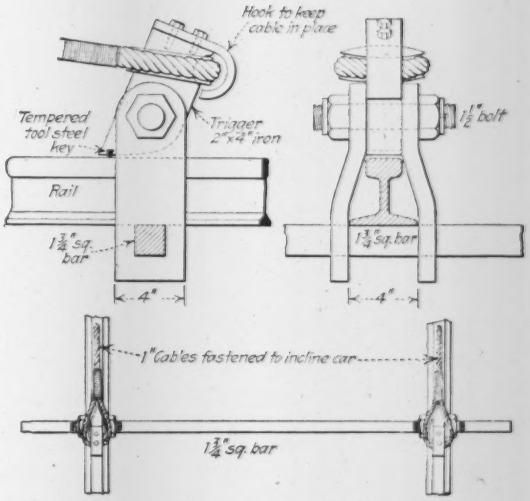
The bunker car contains two bins with a total capacity of 6 cu.yd. From these bins the material is shoveled through doors in the lower end onto an apron attached to the mixer car. The apron is hinged to the mixer car and when in service the upper edge rest on the inclined track. The apron is faced with steel plates and has standing room for two workmen while shoveling material into the mixer skip.



INCLINE PLANT POURING BALCH PENSTOCK FOOTINGS

The mixer, of one-sack batch size, is driven by a gasoline engine; mixer and engine are kept practically level on different slopes by means of the three quadrants consisting of ¼x2½-in. strap iron, as shown in the accompanying illustration. These quadrants have holes through which a bolt can be thrust to maintain the platform at any desired angle up to 40 deg. with the frame of the car on which it is supported.

From the mixer concrete is discharged into a chute



DETAILS OF CLAMPS FOR ANCHORING INCLINE CAR TO RAILS

which leads to the footing forms alongside the incline track. Ordinarily two footings which average about 40 ft. apart are poured between moves of the mixing plant.

The cement comes down to the work in sacks with each load of sand and rock in the bunker car. The man handling cement slides the sacks along a chute placed

beside the bunker car and delivering to the apron. After placing a supply of sacks on the chute this man takes his stand on the apron and empties a sack into each skipload. The mixer crew consists of six men, two in the bunker car, two on the apron, one cement man and one mixer man. This crew when pouring on the larger anchor piers can average 50 to 60 cu.yd. per 8-hr. shift.

One of the most notable features of this rig is the device known as the "tie-out." This is a track lock or connection with which the mixer car can be quickly and very securely fastened to the track, thus making it possible to move the bunker car without interrupting mixer operations. Before this device was developed it was necessary to stop concreting while a new supply of materials was secured or to go to considerable trouble to anchor the cement car. Since this device has been put into use the bunker cars can be replenished while the mixer is operated from the supply of materials stored on the apron.

The "tie-out" consists of a "trigger," in whose upper end is an eye for the attachment of a cable passing around the car, and whose lower end is pivoted so that the pull is transferred to stirrups under the rail. With one of these levers on each rail and a steel bar thrust from rail to rail on the underside and through the stirrups, the more tightly the cable pulls on the lever the more firmly the device is clamped to the track.

The device was developed by Robert Bryant, resident engineer on the project, and was built in the machine shop on the job.

Curb Stones Removed and Reset by Power Shovel

By Allan Wells
Hartford, Conn.

IN WIDENING Franklin Ave., Hartford, Conn., recently it was necessary to remove upwards of 3,000 ft. of granite curbing and reset it. This curb was 6 in. thick, 24 in. deep and in lengths from 6 to 10 ft.

Usual manual methods of removing it consisted in digging by hand a narrow trench along the face nearly to the bottom of the curb. Into this trench the stones would be worked loose by bars and then lifted out by manual means, using bars, blocking, etc. The contractor, H. E. Putnam of Hartford, removed this curb at between one-half and one-quarter of the cost of the above method by using a small power shovel of the type ordinarily employed in excavating cellars.

Starting at one end of a stretch of curb the teeth of the shovel bucket were pressed against the end of the first piece of curb. Crowding the bucket and hoisting at the same time quickly loosened the granite curb, tipping the end of the stone up. A little juggling by the shovel runner and the end was up high enough to place a chain around the stone. Hooking the chain to the bucket the curb was easily pulled the rest of the way out and lifted over into position near the new line. While the laborers were taking the chain off the first stone the shovel moved up to the end of the next.

The shovel crew with two laborers to handle the chain, etc., were able to remove over 500 ft. of granite curb per day. The only trench made at the old curb line was the space actually occupied by the stones. This tended to fill itself by cave-ins, as against the backfilling and cleaning up required when curb is removed by hand. This elimination of a trench on the old curb line was an advantage both to the contractor and the city.

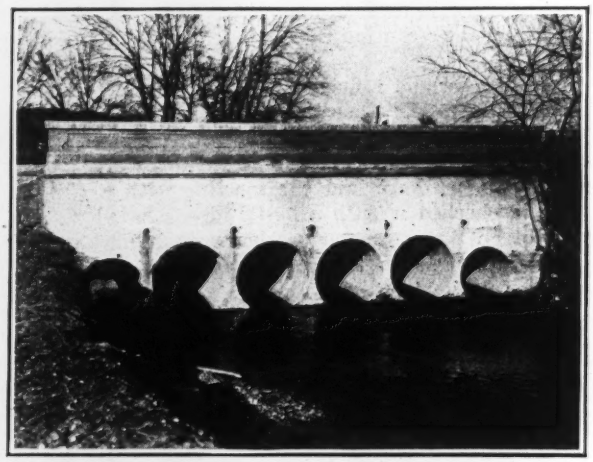
From Job and Office

HINTS THAT CUT COST AND TIME

Unique Use for Corrugated Culvert Pipe

By W. C. Hopkins
Bridge Engineer, Maryland State Roads Commission

WHEN that portion of the state road from Washington to Southern Maryand adjacent to the District of Columbia line was recently improved with concrete shoulders, it was necessary to replace the existing steel through-girder bridge, having a span of 34 ft. over Oxen Run, on account of its narrow width. This section of road has a traffic movement of about 900 vehicles per day. To overcome the necessity of a temporary bridge, which at best would have been a serious detriment to traffic, it was decided to use a battery of pipes under the existing structure and so placed that a bridge could be constructed without a moment's hindrance to traffic, and designed so that the life would be comparable to a concrete structure.



BATTERY OF PIPES FACILITATE BRIDGE WORK

Estimates showed that the cost of a battery of pipes built in accordance with the design shown, and the cost of a double-span bridge with existing substructure encased with concrete, with two new wings, would each be about $5,000. As a matter of interest, the cost of a concrete girder bridge complete with new substructure was found to be $6,300.

In the construction of this structure, a 3-ft. wide L-shaped concrete foundation at the end of the pipes was built together with a wall 2 ft. 6 in. in depth to prevent scouring. The pipes were then placed in position and encased in concrete to a height of 8 in. above the crown of the pipes. This 8-in. section was reinforced with ½-in. square bars on 12-in. centers, in order

From Job and Office

FOR CONTRACTOR AND ENGINEER

to provide for absolute assurance of action regardless of what might happen to the pipe. The spandrel walls were completed and the other half built in the same manner. When the structure was completed, the backfill was placed and the old structure removed, after which the macadam surface was laid.

Procedure for Analysis of Mortars

By James L. Heitzman
Engineer of Tests, E. L. Conwell & Co., Philadelphia, Pa.

In analyzing mortars the first process is to crush a representative sample to ¼ in. size or less, heat it in an iron pan for an hour or so at high temperature, then cool and quarter down to three or four ounces. The sample should then be pulverized and kept in an air-tight container until ready for use.

To analyze, weigh one gram of the sample, transfer it to a 250-c.c. beaker, add 50 c.c. of dilute HCl (1-9) and boil it until all soluble matter is in solution. This should then be filtered, washed well, ignited and weighed. This weight divided by 95, and multiplied by 100 gives the approximate percentage of sand in the mortar. The figure 95 is used because good mortar sand contains about 95 per cent insoluble matter.

Evaporate the filtrate to dryness as in silica determinations. Cool, add 20 c.c. of dilute HCl (1-1), warm until all the iron salts are in solution and then add 50 c.c. of water. After boiling filter this, wash thoroughly, ignite and weigh. The weight of the soluble silicates multiplied by 500 gives the approximate percentage of portland cement in the mortar. The soluble silicates determined by evaporation represents the silicates of the cement. This is usually about 20 per cent. Hence this result multiplied by 5 gives the amount of cement present. If the amount of soluble silicates is very high, it indicates a dirty sand. This, of course, would nullify the calculation based on the soluble silicates, which, fortunately, is a rare occurrence.

Determine the lime and magnesia in the filtrate in the usual manner, discarding the precipitate of alumina and iron hydroxides. Calculate the CaO necessary for the amount of cement by multiplying the latter by 0.625. Subtract the result from the total CaO content. Calculate the MgO necessary for the cement by multiplying by 0.032. Subtract the result from the total MgO. Combine the remaining CaO and MgO, divide by 95 and multiply by 100 to determine the approximate percentage of lime in the mortar. Normal cements average about 62.5 per cent CaO and 3.2 per cent MgO, hence the use of these figures in the calculation. The MgO content varies for Lehigh cements between 2.75 and 3.75 per cent; and other districts contain from 1.50 to 4 per cent, so 3.2 is a fair average. In any case the error introduced at this point is a small one.

Lime for structural purposes contains 95 per cent CaO-MgO based on the non-volatile portion. The total percentage of the cement, lime and sand will be about 95 per cent. The remainder is CO_2 that has not been driven off by heat.

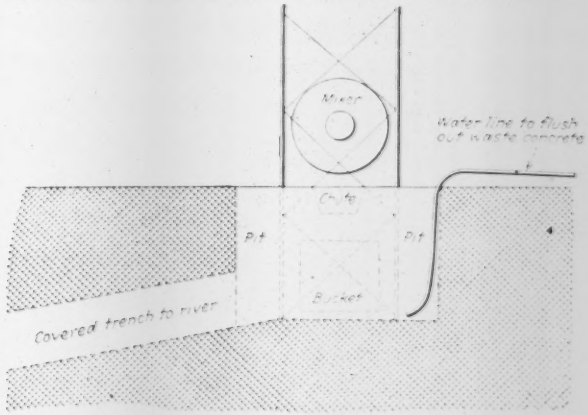
The method here described is not applicable if a "masons" cement has been used.

Flush Tunnel for Waste Concrete

By Wilfred Schnarr
Hydro-Electric Power Commission, Toronto, Ont.

A CONVENIENT way of keeping the bottom of the pit at the foot of a concrete chuting tower free from concrete drippings has been devised by Alex. Robertson, concrete foreman on the extension to the Nipigon powerhouse of the Hydro-Electric Power Commission of Ontario.

As the mixer was at ground level it was necessary to dig a pit for the bucket to travel low enough to receive

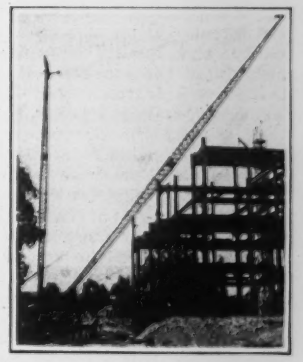


PIT AND TRENCH FOR WASTE CONCRETE

the concrete from the mixer, which was of the tilting type. To keep this pit clear so that the bucket could come to rest properly each time, a small trench was dug, planked over and filled, forming a tunnel 2 ft. square running to the river, a distance of about 30 ft. During concreting operations a hose was used to flush the concrete that spilled from the mixer through this tunnel. Most of the waste material was thus carried away. What did remain was coarse aggregate and it was easily shoveled out of the pit. This arrangement saved much time and hard work.

Job and Office Notes

Operating a Derrick with a 154-Ft. Boom only one set-up is required for the erection of the structural steel on the tower of the new City Hall in Pasadena, California, although the tower is 216 feet high. The derrick consists of a lattice-steel mast 100 ft. long and a lattice-steel boom 154 ft. high. Both boom and mast are built of 3x3x¼-in. Ls and lattice bars of 1¾x¼-in. strap. This derrick sets all the heavy steel up to the sixth floor, at a height of 202 ft. The lighter steel in the dome is elevated by placing a 30-ft. extension on the end of the boom, the loadline being at the bottom of the extension and the boomline remaining at the end of the 154-ft. boom. E. J. Brust is engineer in charge of the city hall job, which is part of the civic center project, for Brombacher Iron Works of Los Angeles, structural steel contractors.—Michael J. Phillips, Pasadena, Calif.



Letters to the Editor

A FORUM FOR DISCUSSION OF VIEWS OF ENGINEERS AND CONTRACTORS

Three-Tie Supported Rail Joints

Sir—Referring to the July 15 issue of *Engineering News-Record*, I was very much interested in the article on p. 93, under the heading of "Rail Joint Practice on Foreign Railways." In the paragraph under the cut which shows the "English Flexible Rail Joint," the first sentence reads as follows: "A low record of rail breakages on the New York Central R.R. was attributed to the use of the three-tie type of suspended joint with long six-bolt splices."

I imagine this was taken from the report of the last International Railway Congress, and the expression used is as follows: "After having pointed out that on the New York Central the proportion of failures within the fish plate zone is very small (one defect within the fish plate zone to 30 outside this zone) it was pointed out that this low proportion was attributed to the use of fish plates 38 in. long, resting on three sleepers (ties), *one of which is under the joint.*"

From this you will note that we do not use a suspended joint, but a supported joint. I feel that the note should be corrected.

J. V. NEUBERT,
Engineer, Maintenance-of-Way,
N. Y. Central R.R.

New York,
July 29, 1926.

[The writer of the article apologizes for a slip of the pen, since the three-tie joint, with its middle tie under the joint, is of course a supported joint. In regard to the Joyce and Roach joints, it should have been stated that the latter has a distinctive feature in the bending of the bars inward at the ends and outward at the center, for the purpose, as claimed by the inventor, of eliminating secondary stresses.—EDITOR.]

Standard Quality Specifications Improve Commercial Practice

Sir—Your brief editorial footnote at the bottom of my letter of June 10 (*Eng. News-Record*, June 24, p. 1035) would indicate that the last paragraph of the latter did not clearly set forth my views. If this part of my letter conveyed the impression that I was inferring that quality specifications would also tend to bar goods above the set standard, I trust this supplemental statement from me will correct any such impression.

While in a great majority of cases all practical requirements would be met by materials furnished under such quality specifications as we are discussing, there will always be special situations where super-quality is required or there will always be some one with ability to pay the price who will demand the better goods. These constitute the exceptions rather than the rule. As long as these demands exist there will be a market for goods above the standard quality and quality specifications will never bar such goods from the market. It is equally true that standard quality specifications will never entirely bar from the market sub-standard goods, because for many purposes such goods answer the purpose equally as well, but they will prevent such goods from being palmed off on the consumer at prices equal to those made under quality specifications. The man with only five dollars to spend for a pair of shoes is not going to go barefoot for lack of footwear just because his taste runs to more expensive shoes. He is naturally going to tide over the emergency situation as best he can with the shoes he can afford at the time. Thus it is frequently a matter of ability to pay.

To illustrate in the opposite direction, while a moderate-priced automobile would convey one satisfactorily for years nd would answer every practical purpose, there will always be a demand for more expensive cars to meet the individual tastes of those able and willing to indulge in such luxuries or comfort. Has the degree of standardization to which the manufacture of Ford or Dodge cars been carried decreased to any appreciable extent the demand for better quality cars? Has this degree of standardization of these two cars had the effect of stagnating their sales? There is certainly no indication that it has done either of these, nor has the mass production of these two cars, under such a general standardization plan, resulted in any noticeable lowering of the quality of the materials entering into their construction, although it has contributed towards an appreciable reduction in their selling price.

There have in the past been a great many articles and materials placed upon the market under trade names. These have been extensively advertised and many extravagant claims made for them and a fictitious value established, and the public has paid the price without knowing just what it was getting in return, although if the truth were known they were no better than other products less advertised and less well known which were being sold at lower prices. Among these might be mentioned tool steels and special steel rods for electric arc-welding work. But the day when people are willing to purchase by trade name only, without knowing what they are getting, is rapidly passing, and the demand for specifications that will widen the field in which a product of certain desired characteristics or involving a certain design can be obtained, is becoming more and more insistent as the consumer realizes the advantages to him. The time is not far distant when the value of a trade name alone will be small, and when a great many products will be advertised and sold under a standard quality specification designation. It is entirely a matter of education, and if more people realized the extent to which such specifications were now available and what was being done to further the movement, their use would spread more rapidly.

The specification movement is the natural and logical result of the ever increasing complexities of modern industry, and to meet the need for more accurate technical control of manufacturing processes. It is here to stay, and thinking and well informed men are not being deceived by any such statements as were contained in Dr. Matthews' criticisms, for while he is sincere enough in his beliefs he has overlooked certain factors in the problem that in these days of modern business control the situation to a very large extent.

HOWARD H. GEORGE,
Assistant to Chief Engineer,
Public Service Production Co.

Newark, N. J.,
July 11, 1926.

Sir—I am interested in the question, Do Standard Specifications for Quality Improve Practice, discussed in your issues of June 3 and 24, pp. 885 and 1035. My experience in this line is limited largely to the purchases by small western municipalities of water-works materials. I know that the American Water Works Association specifications for pipe and water meters have an influence tending to improve small water-works systems in the Intermountain country.

The only specification we receive, particularly from small communities, is that the material comply with the American Water Works Association specifications.

We have tried to impress on city officials that these specifications or any other standard specifications are not standards of excellence, but merely set up minimum requirements for the type of material to which they refer, and we are positive that standard specifications have a beneficial effect on small water-works systems of this territory.

C. E. PAINTER,
Vice-President, Water Works Equipment Co.

Salt Lake City,
July 7, 1926.

Pressures Under Continuous Footings

Sir—On page 70 of your July 8 issue, J. W. Pearl in an article on "General Three-Moment Equation" states that,

"In an effort to determine the distribution of pressure to the soil below a continuous footing under three or more columns, the writer was confronted with a problem upon which all text and reference books at hand were silent. No uniform pressure, or uniformly varying pressure, assumed would simultaneously satisfy the three-moment equation and the known column loads."

The solution of the problem of distribution of soil pressure below a continuous footing under three columns may

be found on page 680 of the Oct. 7, 1920, issue of *Engineering News-Record*, or on page 273 of the writer's book, "Theory of Framed Structures," published by McGraw-Hill Book Co. The solution is given for three cases:

Case I, projections of the footing beyond the outside columns not limited. In this case a solution for the length of each projection and the uniform pressure is given;

Case II, projection at one end limited by site. In this case the projection at one end is fixed and the solution is given for the length at the other end and for the pressure, which is uniformly varying;

Case III, projections at both ends limited by site. In this case the projection at each end is fixed and the solution is given for the parabolic varying pressure.

Chicago, Ill., July 20, 1926. CHARLES A. ELLIS, Vice-President, Strauss Bascule Bridge Co.

Economy and Deflections of Rigid-Frame Concrete Bridges

Sir—In *Engineering News-Record* of April 29, 1926, and in the article, Rigid Frames in Concrete Bridge Construction, by Arthur G. Hayden of the Westchester County Park Commission, there are, I think, several misleading statements, which, if I am right, should be brought to the attention of your readers.

I take exception first to the author's treatment of the question of deflection. The pictures used in the article as Fig. 2 are misleading and the quotation from the discussion by Prof. George E. Beggs before the American Concrete Institute is either over my head or else it is poorly worded. I can see no direct or useful connection between deflections and either internal or external work. Deflection is a matter of angle changes, a problem in geometry. The distortion due to bending is completely determinate if we know the stress in the extreme fibres and the distance, at each point along the beam, from the extreme fibre to the neutral axis of the member. Why should this simple proposition be confounded by the introduction of either internal or external work?

Not only do I find it impossible to agree with Mr. Hayden's treatment of the problem of deflections, but also with his discussion of the relative deflection and economy of structures with continuous framing. Deflection and economy go side by side but generally in opposite directions. The pictures in Fig. 2 do not show this. If the bents had been designed for the same maximum fibre stress, the pictures would, in all probability, tell a different story, for in almost every case the continuous treatment of a problem gives greater economy of material, but more deflection, than does the solution wherein the requirements are met by the use of simple members. This is only true, of course, where the designs are to the same specification.

I hesitate to mention my last question in regard to Mr. Hayden's article because the author gave it only a brief treatment. I refer to the moment curve for dead load in Fig. 11. I do not understand from the author's description and the figure why the analytical and the mechanical analysis should agree so closely at the break in the moment curve occurring between the knee and the footing at minus forty. In fact, I do not see why there should be an abrupt change between the knee and the footing.

If I were entering a discussion instead of a complaint, I would continue in order to endorse Mr. Hayden's remarks concerning the structural and architectural adaptability of continuous construction, but, since such is not the case, I shall now close. CHARLES F. HENDRICK.

Asheville, N. C., July 10, 1926.

Sir—In answer to the above letter:

1. The connection between external work, the corresponding internal work, and the distance through which the working force moves is so fundamental that all that is necessary is to refer to any modern textbook on structural mechanics for a demonstration.

2. The quantity of material in the ideal structure is exactly proportional to the total elastic energy stored in its members. The following reasoning for such an ideal structure is given by Henry Babcock, designer in this department.

Let us assume two designs for the same structure to the same specifications, one a determinate structure as indicated in Fig. 1A of the article of April 29, the other an indeterminate frame as indicated in Fig. 1B. Let it be assumed that all material is stressed to the full allowable working stress in each case under the same external load. The elastic energy stored in the determinate structure due to the flexure of its members is $K \int \frac{s^2 A dl}{E}$.

where s is the allowable working stress in extreme fibre, K a constant depending on the shape of cross-section, A the area of the member for the length dl, and E the modulus of elasticity of the material. Since s and E are constant, they may be taken outside the integration sign, giving internal work = external work $= W = K \frac{s^2}{E} \int A dl$. For the indeterminate structure $W' = K \frac{s^2}{E} \int A' dl$. The expressions $\int A dl$ and $\int A' dl$ obviously represent the total amount Q and Q' of material in the determinate and indeterminate structures respectively. Therefore, $\frac{Q}{Q'} = \frac{W}{W'}$ so that if W' is less than W, it of course follows that Q' is less than Q."

That is, if the deflection under the load is less in the indeterminate structure than in the determinate structure, the former will be more economical of material than the latter. This is usually the case as mentioned below.

3. Mr. Hendricks in his statement that deflection and economy go side by side but generally in opposite directions, seems to recognize the truths that he previously questions. This statement is quite correct but he contradicts himself a few lines further on where he says that "in almost every case the continuous treatment of a problem gives greater economy of material but *more* deflection." The truth is that the continuous treatment gives greater economy because it does in fact gives *less deflection*.

4. Mr. Hendricks' criticism of my use of Fig. 2 implies his belief that if the bents had been designed for the same maximum fibre stress, the deflection would have been greater for the rigidly connected frame than for the simple structure. This is not so, as a matter of fact, as calculations for actual structures have shown.

Frames designed as in Fig. 4 of my article show greater economy than constant-section frames and I would expect less deflection for the former under load than for the latter, but I have not made such comparison of deflections. I imagine that the more favorable disposition of material in the former would tend to decrease deflections. I do know that the deflections for both variable and constant-section frames are less under load than for the simple structure of equal span.

5. The criticism in Mr. Hendricks' fourth paragraph is apparently occasioned by his failure to notice the change in section above the footing which causes the break in the moment curve whether calculated by the analytical or deformeter method. A. G. HAYDEN,

Bronxville, N. Y., July 15, 1926. Designing Engineer, Westchester County Park Commission.

The Travis-Imhoff Litigation in Germany

Sir—In a letter published in your issue of June 24, 1924, p. 1034, H. W. Clark cites a decision of the German Patent Court of 1912 concerning the patent litigation of Dr. Travis against the German Imhoff Tank Patent No. 187,723 of May, 1906. This decision was later annulled by the decision of the supreme court (the German Reichsgericht) of June 17, 1912. The original claims of the Patent No. 187,723 were re-established and Dr. Travis was condemned to pay the whole costs of the case.

I agree with Mr. Clark that this is ancient history, since the basic American Imhoff Tank Patent expired some weeks ago, but it seems desirable to have the record of the case completely given now that it has been mentioned.

Essen, Germany, July 6, 1926. KARL IMHOFF.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Work Dismisses Objections to San Gabriel Dam Site

Application of Los Angeles Flood Control District Approved By Secretary

Following the hearings before the Secretary of the Interior on the question of the location of the construction railway to the proposed dam of the Los Angeles County Flood Control District (*Engineering News-Record*, July 1, 1926, p. 29) the Secretary has issued the following decision:

"The matter of the City of Pasadena *et al. vs.* Los Angeles County Flood Control District has been the subject of investigation by a commission of three engineer employees of the Departments of Interior and Agriculture, appointed by the Secretaries of those departments. The majority of that commission recommends the approval of the application of the Los Angeles County Flood Control District, and the rejection of the protests of the city of Pasadena and others.

"After due notice, an oral hearing was held in the Department of the Interior, at which all parties in interest had opportunity to appear and present their views. Thereafter, they were accorded time within which to file briefs and additional showing, which they have done.

"The Commissioner of the General Land Office, upon review of the entire record, has submitted a lengthy report and recommendation, which is hereby approved. Pursuant to these reports and proceedings, it is held:

"(1) That the application of the Los Angeles County Flood Control District for right-of-way for railroad under the act of March 3, 1875 (18 Stat., 482), must be rejected, because the railroad is not to be built or operated as a common carrier of passengers and freight, either by the district or others.

"(2) The foregoing is without prejudice to the application heretofore filed by the district with the Secretary of Agriculture for a special use permit for the construction and operation of said railroad, which matter rests within the jurisdiction of the Secretary of Agriculture.

"(3) The protests of the city of Pasadena and others against the approval of the application of the Flood Control District for a reservoir site, commonly designated as the Two Forks site, are hereby dismissed, and the application of the district for the site under the acts of March 3, 1891 (26 Stat., 1095), and May 11, 1898 (30 Stat., 404), are approved, subject to removal or revocation of power-site withdraws or reservations on certain tracts, which matter will be the subject of action by the Federal Power Commission.

"If and when this conflict is removed, the Commissioner of the General Land Office is authorized to submit maps of the Flood Control District for the reservoir site for approval in the usual manner."

Engineering Fifty Years Ago

From *Engineering News*, Aug. 1876

THE Syracuse *Journal* says that it is a prophetic fact that very few first-class boats are now seen on the canals of New York, and as none are being built nor likely to be built while the present depression continues, it follows that the day is not far distant when there will be but very few boats of any kind fit for use. There is now no inducement for building boats, and owners of new ones cannot earn the interest on the capital invested. The railroads seem determined to ruin the canals, and with the assistance of state officials high in authority are making good headway.

* * *

On Tuesday of last week the first stone of the new locks of the St. Mary's ship canal was laid with appropriate ceremonies. Gen. Wetzel inspected the stone, pronounced it properly laid and indulged in a speech which was followed by others all agreeing that this canal is destined to be the way of a mighty commerce. The business through this canal in 1875 was 1,290,729 tons. The locks are built on a new plan and the sluiceways are situated under the floor, the filling of the lock taking place from the bottom.

[The traffic through the canal in 1925 exceeded 70,000,000 tons. —EDITOR.]

$2,000,000 Building Program for Nippon Electric Company

The Nippon Electric Company of Tokio, Japan, has begun on a $2,000,000 program for the replacement of the old buildings which it has been using since the earthquake by new buildings of a type designed to resist earthquake stresses. Work on the construction of the first of four 4-story units is well under way and it is expected to be completed in February when part of the operations now going on in the old buildings will be transferred to the new structure. The buildings will be supported upon a special type of pile foundation and will be of heavy structural steel and concrete. The buildings were designed by the H. K. Ferguson Company of Cleveland, Ohio, which company is also supervising construction.

San Francisco Supervisors Hold Transbay Bridge Hearings

The San Francisco Board of Supervisors on Aug. 3 began a series of hearings to receive proposals from those who seek franchises for constructing a bridge across the bay between San Francisco and Oakland. (This does not include the Golden Gate scheme.) The hearings were decided upon after the announcement by the Secretary of the Navy on July 7, that on account of the hazard of military demolition the War Department's 1921 ruling as to requirements for transbay bridges should be continued. Several reviews of previous hearings on this subject have appeared in *Engineering News-Record*, the latest tabulation of proposals being in the issue of Dec. 31, 1925, p. 1086.

The present hearing was decided on in an endeavor to bring the matter to a head and to be able to put before the War Department some complete proposal on which definite action could be taken. The plan was to continue the hearings until all applicants had been heard.

At the outset presentations were lengthy, some applicants taking an entire day to present their case. However, in a period of 4 days a total of 5 proposals had been received as follows: E. W. Davis, combination tube and bridge from Pier 26 to the Oakland mole; R. C. Hackley, a bridge on the same location; John Birmingham, Jr., A. M. Bergstrom and Bay Cities Bridge Corporation, all Hunter's Point to Alameda bridges. Hearings are to be held Tuesdays, Wednesdays and Thursdays of each week until all plans are considered.

Work Started on $6,000,000 Automobile Plant at Pontiac

Work began July 23 on the construction of a $6,000,000 automobile plant for the Oakland Motor Car Co., at Pontiac, Michigan. The new plant comprises over 2,000,000 sq.ft. of floor space and includes a motor plant of single-story design 455 x 880 ft., an assembly building 180 x 1,260 ft., three stories and basement, a foundry 300 x 700 ft., and a car storage building 432 x 760 ft.

Approximately 55,000 cu.yd. of concrete, 500,000 sq.ft. of steel sash, 12,000 tons of structural steel, 500,000 sq.ft. of window glass and 6 miles of mechanical sash operating equipment will be used in the construction of the plant. More than four miles of railroad siding with loading docks are to be built to accommodate 200 cars per day.

An interesting feature of the construction is the installation of conveyors which will allow easy transport of bodies for the Oakland car to its new plant nearby by The Fisher Body Co.

The work is being done by The Austin Co. of Cleveland, from which this information is secured.

Large Arc-Welded Building Placed Under Contract

A contract has just been let by the Westinghouse Electric & Mfg. Co. to the American Bridge Co. for the construction of a five-story building to be erected at the Sharon, Pa., works of the company, for the manufacture of transformers. This building will cost about $255,000 and will include about 700 tons of steel. Shop as well as field connections, including the assembly of plate girders, will be done by arc-welding. This will be the largest completely welded building frame so far built.

Announcement of the contract by W. S. Rugg, vice-president of the company, states that the amount of steel required is about 100 tons less than would have been necessary in a corresponding riveted structure. Bernard H. Prack of Pittsburgh is the company's architect for the building, and G. D. Fish of New York is consulting engineer.

Two welded buildings are at present under construction by the Westinghouse company itself at its East Pittsburgh works. One is a three-story addition to the chemical laboratory, and the other is a high single-story building of mill building type, about 40 x 60 ft., equipped with a crane runway. In both structures all connections are welded, some of the connections and details, such as those of the crane brackets, having been developed by special tests.

Santa Fe Proposes 15-Mile Cutoff Near Los Angeles

The Corona & Santa Fe Ry. Co. has been incorporated as part of the Santa Fe system and has been authorized by the Interstate Commerce Commission to construct a new line forming a connection between existing lines of the Santa Fe in southern California. The proposed new line would extend from Alberhill to Porphyry, a point near Corona. The traffic from the Alberhill-Temecula line could then be moved to Los Angeles with an average saving in distance of about 33 miles as compared with the present route via Corona, and of 46 miles as compared with the present route via San Bernardino. It is estimated that the net saving which would be effected by the shorter haul and quicker service over the proposed line would amount to about $50,000 per year.

Will Test Stress and Vibration Gages Built for Competition

Eight instruments were submitted in a prize competition arranged by the Deutsche Reichbahn Gesellschaft (German Railway Co.) prior to April 1 of the current year for stress and vibration recorders for bridges. Tests are now to be carried out on these instruments to determine their efficiency in carrying out their intended functions. Of the eight instruments, three are pure stress or strain gages, three are vibration gages, and two are combined stress and vibration gages. They embody different methods of operation: mechanical, photo recording and electric.

According to a statement by Dr. Kommerell of the Railway Co., the prize jury after examining the instruments adjudged all of them suited to the required purposes, and recommended them for test (as specified in the competition) to determine their comparative merits. Professor A. B. Hort has been retained to carry out these comparative tests. He has designed for the purpose a shaking table whose true motion is to be recorded photographically. A motor and crank drive permits the table to be operated at the frequencies prescribed in the competition. These shaking tests are to be carried out during July and August at the Dresden Technische Hochschule. Subsequently actual measurements on bridges are to be made at Spiez, Switzerland, and at Oranienburg, Germany.

New Quarters for Cincinnati Engineers' Club

The Engineers' Club of Cincinnati has leased part of the Athletic Building of the Cincinnati Club, and is now remodeling it for new quarters, including a large meeting room, lounging and game room, a library and kitchenette. It is expected that the new quarters will be ready for occupancy by Sept. 1.

Railroad Proposed in Arkansas

The Missouri Pacific Railroad Company has applied to the Interstate Commerce Commission for authority to construct an extension of its line from Nashville, Ark., a distance of 7½ miles in order to develop a peach growing country.

Engineer Named Commissioner for District of Columbia

Proctor L. Dougherty, an engineer, has been named by President Coolidge to be a commissioner for the District of Columbia. Executive authority in the District is vested in three commissioners.

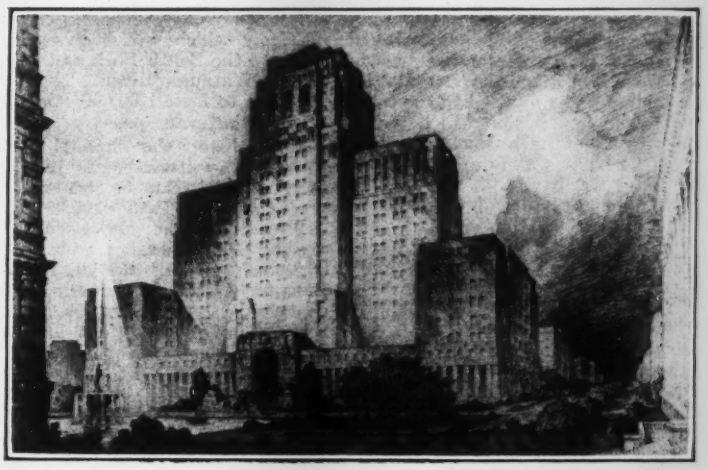
Mr. Dougherty was graduated from Massachusetts Institute of Technology in 1897, where he took the course in electrical engineering. Immediately thereafter he joined the staff of the supervising architect of the Treasury Department as an electrical engineer. Later he became assistant inspector of electric light plants, from which position he was promoted to that of inspector.

In 1910, Mr. Dougherty left the government service to join the technical staff of the Otis Elevator Co. He saw service in that concern's New York and Boston offices, and in 1919 he was made local manager of the Otis company in Washington. Later he was promoted to the position of executive representative of the vice-president of the Otis company, in immediate charge of all business done with the government.

Mr. Dougherty is a member of the Washington Society of Engineers and when engaged in engineering work was active in the American Society of Mechanical Engineers and the American Institute of Electrical Engineers.

Seattle to Vote on Manager Plan Next November

Nov. 2 has been fixed by unanimous vote of the City Council of Seattle, Wash., as the date for a popular vote on the proposed modified city manager plan of government discussed editorially in our issue of April 29, p. 676.



Plans Under Way for 26-Story State Office Building at Albany

There is shown herewith a reproduction of the architect's drawing showing the front elevation of the proposed 26-story state office building to be erected west of the capitol, Albany, N. Y. at an estimated cost of between $5,000 000 and $6,000,000. The state architect is preparing plans and specifications which will be submitted to the State Office Commission not later than Nov. 1. Bids for the erection of the building will be taken not later than Dec. 31 of this year, after which time the commission will go to the legislature for an appropriation to be made out of proceeds of bonds for permanent improvements.

WASHINGTON NOTES

THE Tennessee Eastern Electric Co. has applied to the Federal Power Commission for a preliminary permit covering the construction of three dams on the Nolichucky River in Tennessee. One of the proposed dams is to be 70 ft. high. It is to be twelve miles downstream from the company's present dam. Another dam, 70 ft. high, is to be located at Buckingham Ford. The third dam is to be 90 ft. high and will be located at Embreville. It is planned to install 70,000 hp.

MAJOR Thomas M. Robins has taken charge of the Miscellaneous Civil Section in the office of the Chief of Engineers. This section, among other things, passes on applications for bridge permits.

TO COMPLY with the desires of the Rivers and Harbors Committee of the House of Representatives, the Chief of Engineers has reappointed the board of engineers that made a study of 20 and 25-ft. depths on the Lakes to Hudson waterway. The board is headed by Brig. Gen. Herbert Deakyne, Assistant Chief of Engineers. The other members are Col. Spencer Cosby, division engineer for the Great Lakes division; Maj. Dewitt C. Jones, district engineer of Buffalo; Maj. Paul S. Reinecke, assistant chief engineer of the Federal Power Commission and Capt. A. B. Jones, assistant to the district engineer of Buffalo.

Under its new assignment, the board will estimate the costs of a 30-ft. waterway.

ADDITIONAL data submitted by the Ozark Hydroelectric Power Co. does not convince the staff of the Federal Power Commission that its plan for the development of the White River in Arkansas is as comprehensive as that of the White River Power Co. The Ozark company has apealed to the commission. The commission will listen to the arguments of its own staff and to those of the parties at interest on July 28.

The Arkansas Railroad Commission recently announced that it had cancelled the state rights of the White Rriver company. The company, however, contends that there is not good cause for the revocation of its rights and has carried the matter to the courts. The White River company took over the rights of the Dixie Power Co. It is a North American subsidiary. It plans to transmit the power to St. Louis.

The Ozark Company is an Electric Bond and Share concern. Its plan is to feed the power into the interconnected system being developed in the South.

THE Tennessee Eastern Electric Co., of Johnson City, Tenn., has applied to the Federal Power Commission for a preliminary permit covering a project on the South Fork of the Holston River near Kingsport. This application conflicts with that filed previously by the Holston River Power Co.

The Tennessee Eastern proposes to put in a dam 100 ft. high at a point ten miles above Kingsport, creating a reservoir which will back water eight miles up the South Fork and four miles up the Watauga River. The company proposes to install 60,000 hp.

WORK on the channel at Miami, Fla., will be begun just as soon as the plant can be adapted to the project. More than $100,000 is being expended on the old Corozal ladder dredge. That dredge was used very effectively during the digging of the Panama Canal in handling material containing a considerable amount of rock. Similar conditions are faced in carrying the 18-foot channel to a 25-foot depth.

The work will be under way by October 1, it is believed, and will be completed in ample time for the business of the fall of 1927.

CONVERSION of the Chesapeake and Delaware Canal to a sea-level waterway will have been completed by the end of the year with very slight interruption to navigation, Chief of Engineers Jadwin believes. Gen. Jadwin inspected the work on July 24. The sea-level canal will have a controlling depth of twelve feet.

Three Airmap Contracts Let

The Airmap Corporation of America has been awarded contracts for supplying airmaps of Nassau and Westchester counties, and the city of Syracuse, N. Y., and environs.

The airmap of Nassau County which was authorized by W. Fred Starks, county engineer, for the county board of supervisors, will be delivered at a controlled scale of 1 in. equals 400 ft. and will consist of fifty-one 3 ft. x 3 ft. units.

The Westchester County airmap which was awarded by the park commission will be assembled and delivered at a controlled scale of 1 in. = 1,000 ft. and in addition, 2 ft x 3 ft. atlas sheets are to be prepared at a scale of 1 in. = 500 ft.

The survey of Syracuse, N. Y., and environs, will be delivered at a scale of 1 in. = 1,000 ft., and will be used for city planning and drainage studies.

P. R. T. Starts Washington-Philadelphia Air Service

On July 16 the Philadelphia Rapid Transit Co. inaugurated passenger air service between the Navy Yard, Philadelphia and Hoover Field, Washington. Planes leave Philadelphia at 9:30 a.m. and 1:45 p.m. and Washington at 12 noon and 3:30 p.m. The distance is 125 miles and the scheduled flying time 1½ hr. The fare is $15 one way and $25 round trip for a 15-day ticket, and the company operates its own buses to the field without extra charge. Seats are provided for 8 passengers each of whom is allowed 30 lb. baggage free; baggage is carried in a separate compartment.

RANDOM LINES

The Editor Explains

Down Mobile they are building a bridge. The editor of the Mobile *Register* saw it the other day and as becomes a good editor he set out to write a piece about it. Apparently it is quite a bridge because it has a new device or fitting or dingus connected with it called a "drib." Knowing that his readers would not understand exactly what a "drib" is the editor kindly explains:

"In an interesting state of construction now is one of the two piers on which the central span of the bridge is to rest. Nothing of it appears above the water-line except the top of a 'drib.' Drib is a word not found in Webster's dictionary as a synonym for caisson or coffer dam, but one freely employed by an engineer who seems to know what he is talking about. It is a great shaft sunk into water and ooze, and kept reasonably dry by steam siphons. Looking down into this shaft, one sees the upper extremities of wooden pilings at the level of minus 21 feet. Their lower extremities have found a firm footing at minus 105. They are already embedded in solid concrete built up from minus 40 for the full width and breadth of the pier. On top of them come steel—and more concrete. And then the span."

* * *

Why Contractors Go Mad

Sir—Here is one to add to the list. It is in the "General Conditions" of the specifications for a job we are figuring at the present time.

"Anything reasonably implied in order to make a complete and finished job is to be provided and furnished and the work performed the same as if shown on the drawings and called for in the specifications." J. E. W.

* * *

What a Piece of Work Is Man

Senator Copeland, of New York, wants the government to undertake the proper study of mankind. He has introduced a bill which provides for a "scientific study of man . . . along anthropological, psycho-physical and statistical lines" and for that purpose there is authorized a position "at an annual salary of $2,000."

* * *

Two Letters

Engineering News Publishing Co.
New York City
Dear Sir:—

Having been elected County Surveyor, I would like to have a Book of Instructions on surveying.

Yours truly,

July 26, 1926

*

Engineering News-Record,
New York, N. Y.
Gentlemen:—

Kindly send me, at your earliest convenience, information regarding a situation as dentist in South America.

Respectfully yours,

July 27, 1926

Municipal University Established at Wichita, Kansas

The Municipal University of Wichita has been established through the gift of over $500,000 worth of building, land, equipment and endowments from Fairmount College to the city of Wichita, Kans. A referendum vote was taken in the city on April 24 on the subject of accepting the gift and establishing the university. The city will provide for the support of the university by a tax allowance not to exceed two mills.

The university will consist of four colleges at the start, the Fairmount College of Liberal Arts, the College of Business Administration and Industry, the College of Fine Arts, and the College of Education. Preliminary courses in engineering, medicine and law will be given in the College of Business Administration. These courses will be co-operative and will be patterned after the Cincinnati plan. The university will open September 13 with Dr. Finlayson, former president of Fairmount College, as president.

Contract Let for Buildings of Large Manufacturing Plant

Contract for the construction of the plant of the Canadian Celenese Co. at Drummondville, Quebec, has been let to the Foundation Company of Canada. The estimated cost of the entire project is $7,000,000.

Engineering Societies

Calendar

Annual Meetings

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Meeting, Providence, R. I., Sept. 14-17, 1926.

INTERNATIONAL CITY MANAGERS' ASSOCIATION, Lawrence, Kansas; Annual Convention, Colorado Springs, Colo., Sept. 21-23, 1926.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York, N. Y.; Annual Convention, Philadelphia, Pa., October 4-9, 1926.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York City; Annual Meeting, Buffalo, N. Y., Oct. 11-14, 1926.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, Washington, D. C.; Annual Convention, Pinehurst, N. C., Nov. 8-12, 1926.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Louis, Mo.; Annual Meeting, Washington, D. C., Nov. 8-12, 1926.

THE ASPHALT ASSOCIATION, New York City; Annual Meeting, Washington, D. C., Nov. 8-12, 1926.

The American Ceramic Society will hold its summer meeting Aug. 30 to Sept. 2 at Philadelphia, Pa.

The Duluth Engineers Club at its annual meeting Aug. 2 elected the following officers:

S. E. Atkins, president; L. M. Pharis and J. A. Noyes vice-presidents; H. W. Richardson, secretary; and F. Ballus, treasurer. The club voted in favor of changing the name of the Minnesota Federation of Architectural and Engineering societies to the Architectural and Engineering Council.

Personal Notes

MAJOR JOHN C. H. LEE, who has been chief of the intelligence division in the office of the Chief of Engineers at Washington, D. C., has been transferred to Vicksburg, Miss., for river and harbor work. MAJOR CHARLES L. HALL, formerly of the press relations division of the War Department, succeeds Major Lee as chief of the intelligence division. MAJOR GORDON R. YOUNG, Washington, D. C., resident member of the Rivers and Harbors Board, is sent to the General Staff College at Leavenworth, Kansas. MAJOR DANIEL L. SULTAN, formerly at the Army War College, succeeds Major Young in the office of the Chief of Engineers as resident member of the Rivers and Harbors Board.

ERNEST L. BLAIR, formerly with Lockwood, Greene & Co., Inc., as mechanical engineer in the steam department, has joined the Stone & Webster organization in its Boston office, as building service engineer in the structural division.

A. E. ROLINSON, formerly city manager of Redding, Calif., has been appointed city manager of Santa Barbara, Calif.

GEORGE A. SCHWABLAND has been appointed city engineer of Maywood, Calif., succeeding Vaughn Wood.

L. W. HELMREICH, chief electrical and mechanical engineer for the Missouri State Public Service Commission, Jefferson City, Mo., has resigned to become general superintendent of the Jefferson City Water Co.

JEAN M. ALLEN, consulting engineer, formerly with the Reynolds Dredging Co., of New Orleans, La., has severed his connection with that company and has opened an office at 2047 McCormick Building, Chicago, Ill., for practice in dredging and allied work, dredging machinery, contractors' and marine equipment, and sand and gravel plants.

JOSEPH A. KITTS and LEWIS H. TUTHILL, concrete technologists, announce their association under the firm name of Kitts & Tuthill, with offices in the Mill Building, San Francisco, Calif., as consultants in aggregate and concrete production control, concrete laboratory, proportioning and production methods, tests, research, specifications for concrete, and related engineering.

PROF. WHITNEY C. HUNTINGTON, head of the department of civil engineering at the University of Colorado, has been appointed professor of civil engineering and head of the department at the University of Illinois to succeed Prof. C. C. Williams, who recently resigned to become dean of engineering in the University of Iowa. Professor Huntington has been connected with the University of Colorado since he graduated in 1910 with the exception of one year which he spent in travel and study, and has been head of the department of civil engineering since 1919.

K. H. SMITH, formerly chief engineer of the Nova Scotia Power Commission, also district chief engineer of the Dominion Water Power and Reclamation Service of the Maritime provinces, located at Halifax, is now associated with the Montreal Engineering Co., Ltd., Montreal. Mr. Smith retains his connection with the water power branch in a consulting capacity.

L. R. BROWN, who has retired from the position of city engineer of Sault Ste. Marie, Ontario, has been appointed construction engineer with the Newfoundland Power and Paper Co., of Corner Brook, Newfoundland.

S. EASTMAN ROOT has been appointed construction engineer with William I. Bishop, Ltd., on the extension to the mill of the Belgo Canadian Co. at Shawinigan Falls, Quebec. Mr. Root was at one time with the Thompson Starrett Co. on the construction of the mill at Three Rivers, Quebec, for the St. Maurice Paper Mills, Ltd.

F. D. NASH, employed for some months past as chief of the locating department of the Byrne Brothers Construction Co., who have the contract for building the Mexican national highways, has been appointed general superintendent of construction with headquarters in Mexico City.

Obituary

CHARLES W. WHITTLE, civil engineer in the Highways Department of Baltimore and for 22 years employed by the city government, died Aug. 3 at his home in Baltimore.

DAVID A. HARTWELL, commissioner of public works at Fitchburg, Mass., who installed there one of the earliest Imhoff sewage treatment systems, died Aug. 3 as the result of a shock; his age was 68 years. Mr. Hartwell was city engineer at Fitchburg for twenty years and later was chiefly concerned with advancing the development of sewage disposal works and with the construction of a comprehensive sewer system for the city.

DR. EDGAR KIDWELL, of the Kidwell Boiler Co., Milwaukee, Wis., died in Berkeley, Calif., July 7. Dr. Kidwell was an active mechanical and electrical engineer, and was known for many articles on some structural subjects and on the design and use of boilers.

S. P. TRIMBLE of Pittsburgh, a member of the executive committee of the National Association of Building Trades Employers and a member of the firm of William F. Trimble & Sons, general contractors, died on July 15 following a sudden attack of acute indigestion.

Construction Equipment and Materials

A SECTION DEVOTED TO WHAT THE MANUFACTURER IS DOING FOR THE ENGINEER AND CONTRACTOR

HOW GERMANY STAGES ITS LARGEST INDUSTRIAL EXHIBIT

The Leipzig Trade Fair, which has been held continuously for about seven hundred years, and has become the largest exhibit in the world, will be held from August 29 to September 4. In 1914 there were 4,000 exhibitors, while last year 10,500 were present. There are a hundred special buildings, with 4,000,000 sq.ft. of exhibition space. Twenty countries, including the United States, will send exhibits this year. Several countries have special buildings.

New Structural Steel Plant for Chicago

The Mississippi Valley Structural Steel Co., of Decatur, Ill., and St. Louis, Mo., will build this summer a steel fabricating plant in the Chicago district, to be located on an 18-acre tract of land at Melrose Park and to have an annual capacity of 15,000 tons, with provision for enlargement. The present plants at Decatur and St. Louis have each a capacity of 18,000 tons. No decrease in the activity of the older plants is contemplated. One of the major reasons for establishing this new plant is the elimination of the "Pittsburgh plus" charge on steel. W. M. Wood is president and treasurer of the company; R. D. Wood, vice-president and general manager; G. A. Caldwell, vice-president and general superintendent; F. W. Ives, secretary.

Business Notes

ERIE PUMP AND ENGINE WORKS, Medina, N. Y., announces the appointment of S. H. Sutton as Manager and the following representatives in the eastern and central districts: Royal C. Wise, Chicago, Ill.; Farrar Pump & Machinery Co., St. Louis, Mo.; Fuchs Equipment Company, Omaha, Neb.; Cameron & Barkley Company, Tampa, Fla.; Woodward, Wight & Co., New Orleans, La.; Aumen Machinery Company, Baltimore, Md.; Dredging & Mining Supply Co., Detroit, Mich.

RACINE RADIATOR CO., Racine, Wis., announces that Ivan Racheff has been appointed Metallurgical Engineer for the company for chemical and metallurgical research in connection with radiators for power units, industrial, truck and heavy-duty type radiators.

CONCRETE REINFORCING STEEL INSTITUTE, Chicago, will hold its semi-annual meeting at the French Lick Springs Hotel, French-Lick, Ind., Sept. 13 to 15. In addition to committee reports there will be two papers: "Conditions on the Pacific Coast," by Edward L. Soulé, San Francisco, and "The Development of Concrete Reinforcement," by A. E. Lindau, Chicago.

THEODORE P. KIMMAN, works manager of the Cleveland plant of the Chicago Pneumatic Tool Co., died at his home on July 24, from heart disease. He was the inventor of the first four-piston air-drill and was associated with Edward N. Hurley, chairman of the Shipping Board, in the development of air drills. He was superintendent of the Cleveland plant from 1903 to 1921 when he succeeded his brother, H. J. Kimman, as works manager.

HARNISCHFEGER CORP., Milwaukee, has made H. A. Wolcott, formerly in charge of its Miami office, district manager of the New York territory. S. B. Bubier has been appointed as sales engineer of the Miami, Fla., district, and H. S. Beale as sales engineer in the New York territory.

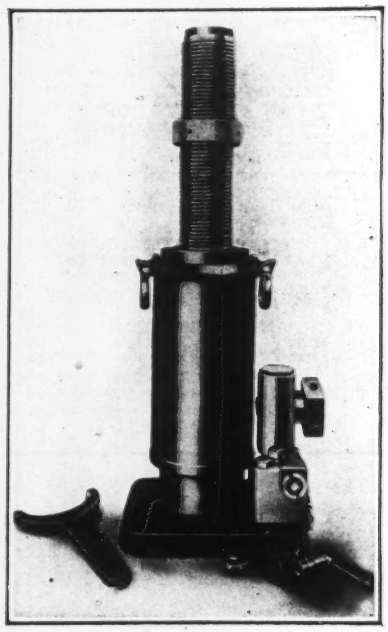
New Developments

Portable Centrifugal Pump Driven by Gasoline-Kerosene Engine

Designed for a range of duty between a 5 and 35-ft. head, the new engine-driven centrifugal pump manufactured by the Economy Pumping Machinery Co., Chicago, Ill., is suitable for trench and foundation construction, summer camps and other installations away from electric service. The pump is a 3-in. type driven by a 5-hp. gasoline-kerosene engine. An important feature is that it will handle a maximum amount of water under all designed heads and yet will never demand the exertion of full engine power. It is furnished with or without a truck as desired. The pump casing is of cast iron of the single-suction, horizontal split type. Either a cast-iron or bronze impeller of the single-suction inclosed type is used and designed to handle a large percentage of solid matter. The engine is air-cooled and all wearing parts are inclosed and run in a bath of oil.

Heavy Duty Oil Jacks Are Light and Compact

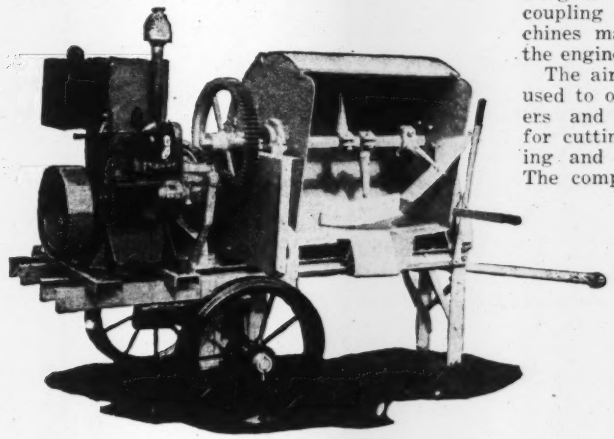
A new hydraulic type jack using oil has been developed by the Watson-Stillman Co., New York. It is claimed to be especially safe and fool-proof. It is made in two capacities, 20-40 tons and 40-75 tons. Compactness and lightness are two features, together with



the fact that there are only five working parts, all of which are on the outside and easily accessible. The ram cap is a separate piece, and can be made any length to give heights of jacks from a minimum of 20½ in. to 42 in. The oil is held in a leak-proof reservoir, and since no refilling is required the danger of dirt getting in the system and clogging the valves is eliminated.

New Plaster Mixer of Sturdy Construction

Built upon the principle that "It shovels as it stirs and thrusts from end to end as it trowels," the new plaster mixer of the Bystone Manufacturing Co., Cambridge Springs, Pa., is offered to the construction field. It has a capacity of 5 cu.ft. with inside dimensions of 30x30½ in. Acetylene-welded ¼-in. steel is used for the heads and shell. The height of the charge is 50 in., while the 8 in., discharge spout is standard wheel-barrow height.

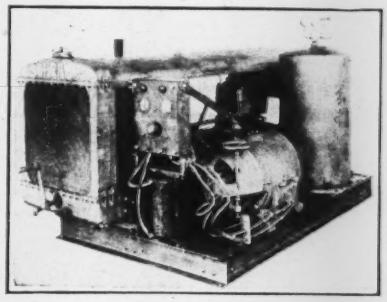


The frame consists of four 3-in. channels, two under the engine and two running the full length of 77 in. The equipment is portable, mounted on metal wheels with solid rubber tires and guarded against vibration shocks by means of ½-in. spiral springs. The power plant furnished is either a 3-hp., single cylinder, hopper-cooled LeRoi or a horizontal hopper-cooled Fuller and Johnson gasoline engine. Dump control and clutch control levers are both at the head end of the mixer. Alemite lubrication is used throughout.

Compressor-Arc Welder Unit for Field Service

A combination air compressor and arc welder driven by a gas engine and mounted on a single base has been placed on the market by Schramm, Inc., of West Chester, Pennsylvania. The outfit consists of a Buda gasoline engine, a Schramm compressor and a General Electric welding outfit. The complete equipment may be mounted on a standard two-ton truck or can be made portable by adding steel or rubber-tired wheels.

The Buda engine is a 24-horsepower, 800 r.p.m. unit which may be started and operated independently of either the compressor or welding generator. The Schramm compressor is a two-cylinder, water-cooled machine with a capacity of 120 cubic feet per minute and equipped with an automatic unloading device. The air receiver is



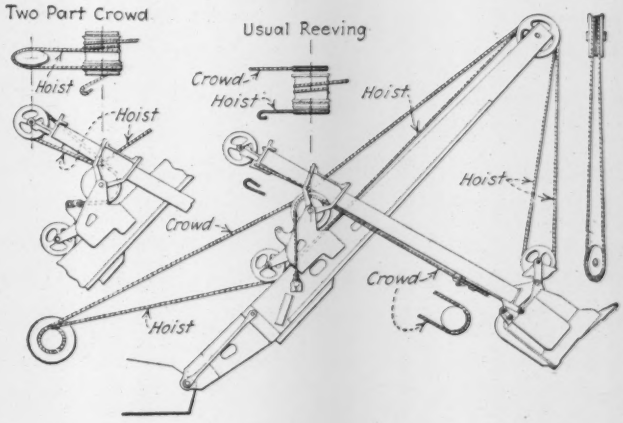
16 inches in diameter by 42 inches high. The General Electric welding equipment consists of a belt-driven WD-12 arc welder with an idler pulley for belt tightening. By the use of a Borg & Beck 12-inch clutch coupling either of the machines may be connected to the engine.

The air compressor can be used to operate drills, grinders and chipping hammers for cutting, peening, caulking and cleaning off scale. The compressor can also be used in preparing work for welding. With the G-E WD-12 welder light and heavy gage steel can be welded as well as cast iron. After the welding is completed, the compressor-clutch is thrown and the weld can be ground or chipped as desired. Thus a complete job can be done with the single machine.

The structural steel base is 8 ft. 4 in. long, 5 ft. 11 in. wide. The outfit is 3 ft. 10 in. high. The total net weight of the outfit is 4,000 lb.

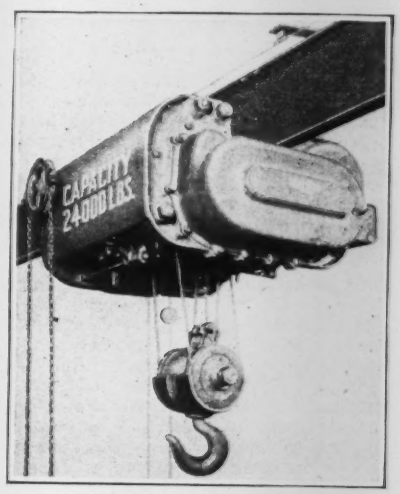
Modified Design of Shovel Crowd

A two-part line-reeving for use where particularly heavy materials are encountered has been developed by the Northwest Engineering Co., Chicago for use on its shovels. The hoisting line (A) runs from the left hand drum under the guide sheave over the boom point sheave and then down around the padlock sheave. It then continues back over another boom point sheave and down to a wide faced sheave which turns freely on the shipper shaft. Two wraps are taken around this sheave and from there the operator has the choice of running the cable to a dead end at the inner end of the dipper stick, or the use of the two part crowd. In the latter case the hoist cable continues around a sheave at the head of the dipper stock and thence down to a non-rotating guide sheave on the shipper shaft where it is dead ended. The crowd-in cable (B) runs from the right hand drum to a sheave on the shipper shaft down to a sheave at the dipper stick end casting and back to a stationary sheave on the shipper shaft where it is dead ended.



Electric Hoist Available in Six New Sizes

Six new electric monorail hoists, in capacities of 3, 5, 6, 8, 10 and 12 tons, have been announced by the American Engineering Co., Philadelphia, complet-



ing the company's line of hoists ranging from ½ to 12-ton capacities. Each of the new hoists is made in types for bolt suspension, hand geared trolley, motor trolley and cab control. Open and closed cabs are provided.

In all the hoists the drum and motor are placed on opposite sides of the I-beam track, upon which the hoist operates. The ball-bearing hoist motor is totally inclosed and drives the drum by spur gears running in oil. Safety features include a factor of safety of five in the design of

the hoist, an upper limit stop and a quick-acting brake that is applied automatically when the current is turned off. The accompanying illustration shows the drum end of the hoist. The motor is on the opposite end, the block rising between them so as to give a maximum of head room.

All Steel Hand Hoist

A hand hoist of five-ton capacity, requiring a space 16x17 in., and 13 in. high, is a product of Beebe Bros., Seattle, Wash. It is a compound-geared hoist with two quickly shifted main speeds. Gear ratios from 4:1 to 24:1 are obtainable for rapid hoisting and heavy loads respectively. The handle is adjustable from 12 to 18 in. in length. The cable drum is 5 in. in diam., 8 in. wide, with flanges 3½ in. deep.

The hoist is equipped with a cam action internal steel brake, lined with wire-inserted brake lining, giving a 4:1 braking ratio on the drum. The crank and pinion are entirely removable for rapid lowering with the brake or running out the cable. The brake is self-locking.

New Publications

Blower System—KIRK & BLUM MFG. CO., Cincinnati, Ohio, has issued a 50 page catalog fully describing its blower systems for collecting, ventilating and conveying. The booklet is replete with illustrations of installations and in the back is given a 5 page list of some of the well known users of these systems classified by industries.

Pyrometers—BACHARACH INDUSTRIAL INSTRUMENT CO., Pittsburgh, Pa., in its latest bulletin No. 293 describes its type H-K Optical Pyrometer for the measurement of extremely high temperatures. The bulletin includes a technical discussion of the use of optical temperature measurements and a 3-page table is given, segregated into industries and operations within the industries, in which these pyrometers can be used. The methods of making determinations and corrections are given in each case.

Elevated Steel Tanks — CHICAGO BRIDGE & IRON WORKS, Chicago, entitles its latest catalog "Horton Tanks for Fire Protection." It contains 24 pages devoted to descriptions and illustrations of the company's hemispherical and ellipsoidal bottom tanks, together with tables of capacities and dimensions. Some notice is also given to the dimensions of standard elevated tanks, to feature tanks that the company has built for advertising purposes and to flat bottom tanks.

Centrifugal Pumps. — DEAN HILL PUMP CO., Anderson, Ind., devotes Bulletin No. 1401 to a description of the application of its centrifugal pumps. Cross sectional drawings of the equipment are shown, giving standard dimensions.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

This Week's Contracts—Week Ago—Same Week Last Year

THE money value of contracts reported in the present issue of *Engineering News-Record* is here compared with the figures for corresponding weeks. Minimum costs observed are: $15,000 for water-works and excavations; $25,000 for other public works; $40,000 for industrial and $150,000 for commercial, educational, religious and other buildings.

Money Value of Contracts Let—Entire U. S.

Week Ending	Public Work	Private Work	Total Contracts
Aug. 12, 1926	$22,002,000	$38,919,000	$60,921,000
Aug. 5, 1926	36,779,000	34,230,000	71,009,000
Aug. 13, 1925	18,556,000	56,302,000	74,858,000
Heaviest Week			
1926, Mar. 11	13,029,000	73,613,000	86,642,000
1925, Sept. 3	16,215,000	69,424,000	85,639,000
January 1 to date			
1926	689,438,000	1,104,628,000	1,794,066,000
1925	647,128,000	828,272,000	1,475,400,000

Actual Contract Totals as Related to Seasonal Variation and Secular Trend

Comparisons Since 1913 Show 1918, 1919, 1920 and 1925 To Be Most Abnormal Years

THE relation of actual contract letting to the regular seasonal variation in awarding of projects, on a money value basis, is illustrated in Fig. 1 on the opposite page.

The straight line projection in this chart is the secular trend or line of new construction demand, brought about by higher standards of living and desire for better accommodations, regardless of whether or not shortage actually exists.

The dotted line, showing the same characteristics throughout each year, is the curve of seasonal variation in contract letting or the movement of awards (total money value each month) as governed by the seasons. The low points in the seasonal variation curve mark the cold months at the beginning and end of each year, while the yearly peaks occur in midsummer. Agitation for an increasingly greater volume of winter construction has not yet had the effect of flattening out the seasonal curve to an appreciable degree.

The fluctuating black line in Fig. 1 shows actual money totals of engineering construction contracts as published monthly in *Engineering News-Record.*

During the years 1913 to 1917, inclusive, contract letting proceeded with seasonal regularity while the period 1918 to 1920, inclusive, and the peak year 1925, showed abnormal gains and losses, from month to month, compared with the curve of seasonal variation.

The year 1921, though one of industrial depression, shows the most marked conformity to the seasonal curve, of any of the thirteen depicted.

Thus far, 1926 has developed greater abnormalities than were present during the corresponding period last year. It is expected, however, that beginning with the current month, the volume of contract letting will run somewhat below that of the last five months of 1925, resulting in a 1926 total fully as heavy as the peak year 1925 if not slightly ahead of it.

Fig. 2 on p. 281 depicts the regularity with which contract letting has progressed since 1922, compared with the nine preceeding years.

This chart is corrected for seasonal variation and secular trend and shows the per cent rise or drop, in money value of contracts let from month to month, in relation to the arbitrary no-change line, designated by zero.

Figures used in these computations are from the Construction News Section of *Engineering News-Record* and cover engineering construction projects for the entire U. S. at the following minimum values: Water-works and excavations, $15,000; other public works, $25,000; industrial buildings, $40,000; and $150,000 for commercial, educational, religious and other buildings.

(Continued on p. 281)

Steel Orders Increase

Unfilled tonnage on books of the U. S. Steel Corporation, July 31, was 3,602,522 as against 3,478,641 tons on June 30 and 3,539,467 tons, July 31, 1925.

This represents the first gain in bookings since December, 1925 and is significant of improvement in forward buying, owing to the fact that July is seasonably slow.

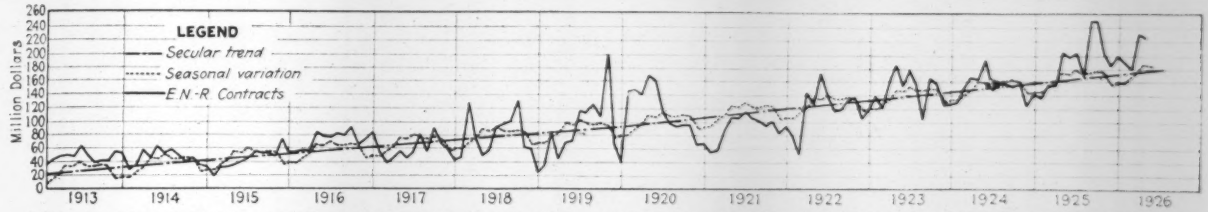


FIG. 1—RELATION OF ACTUAL MONTHLY CONTRACT VALUES TO SEASONAL VARIATION AND SECULAR TREND

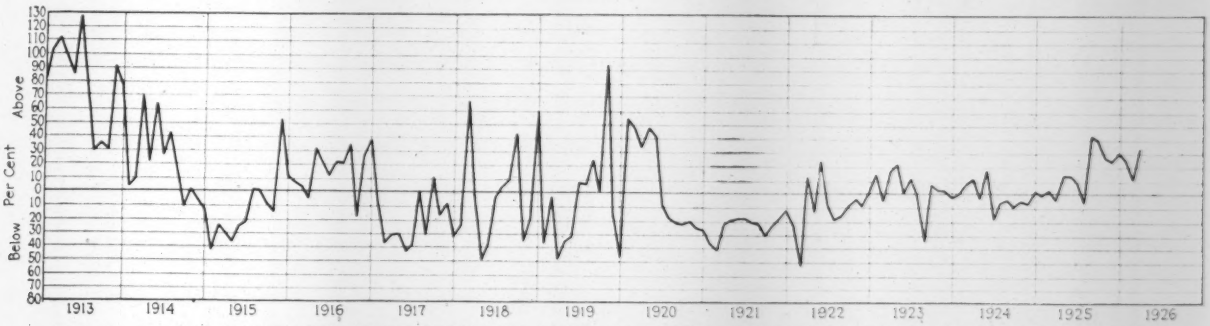


FIG. 2—E. N.-R. CONTRACTS CORRECTED FOR SECULAR TREND AND SEASONAL VARIATION AS RELATED TO NO-CHANGE LINE DESIGNATED BY ZERO

Unit Prices on Highway Materials in Place

IN the following tabulation a comparison is made of unit costs of surfacing and excavating, also reinforcing steel and structural concrete in place, on various highway jobs throughout the country. Average hourly wages paid common laborers and average distances that materials were hauled to the job, are also shown. These figures are taken from contracts awarded since the first of the year and cover six different classes of road work.

BID PRICES, BUREAU OF PUBLIC ROADS, U. S. DEPARTMENT OF AGRICULTURE

County	Contract Let to	Type	Thickness of Surfacing, Inches	Unit Prices Bid—Materials in Place: Surfacing Sq. Yds.	Surfacing Unit Price	Excavation Cu. Yds.	Excavation Unit Price	Structural Concrete 1-2-4 Cu. Yds.	Structural Concrete 1-2-4 Unit Price	Steel Reinforcing Lbs.	Steel Reinforcing Unit Price	Average Haul, Mi.	Average Hourly Wage, Common Labor
KENTUCKY													
Larue	Mason, Douglas & Handley, West Point, Ky.	Graded and drained	....	.....	.....	26,989	$0.35						
						1,600	1.50*	778	$21.00	70,881	$0.05	15-20	$0.25
OHIO													
Summitt	Hamberger & Wager Eng. & Const. Co., Sandusky, Ohio	Brick & concrete	11	.....	.....	29,269	.58			15,681	.05	2	.45
			9			1,265	2.00*	62	15.00	7,232†	.10		
OREGON													
Deschutes	Carl Nyberg, Spokane, Wash.	Cr. Rock	8	14,000	$4.40	.....	.....	.....	.....	.....	.....	3	.50
Lincoln	Union Bridge Company, Portland, Oregon		....	.....	.....	.....	.....	320	30.00	350,000	.08†	53	.50
										29,000	.07		
PENNSYLVANIA													
Perry	Ancon Const. Co., Upper Darby, Pa.	Graded and drained	....	.....	.....	.....	.....	297	28.00				
								80	23.00‡	66,800	.10	...	.50
Schuylkill	David Schoentag, Saugerties, N. Y.	Reinf. Conc.	8	.....	.....	.....	.....	61	35.00				
								687	20.00‡	15,807	.10	3½	.50
Mifflin	Lord Const. Co., Hastings, Pa.	Reinf. Conc.	7½	.....	.....	.....	.....	10	30.00	2,748	.10	6½	.40
Bradford	M. Bennett & Sons, Indiana, Pa.	Reinf. Conc.	8	.....	.....	.....	.....	113	30.00				
								186	19.00‡	25,440	.10	5½	.45
Bradford	Colonial Const. Co., Pittsburgh, Pa.	Reinf. Conc.	6	.....	.....	.....	.....	167	28.00				
								1,009	24.00†	32,947	.07	3½	.45
IOWA													
Cass	Chris Nelson, Omaha, Nebraska		....	.....	.....	91,318	.21	.....	.....	.....	.....	...	.35
Allamakee	J. C. Parquette, Des Moines, Ia.		....	.....	.....	85,588	.27	.....	.....	.....	.....	...	.35
MISSISSIPPI													
Clarke Co.	Champenois & Blanks, Meridian, Miss.	Earth	....	.....	.....	131,083	.30	1,114	24.40	91,389	.05½	6	2.50
NEBRASKA													
Washington	Yant Const. Co., Omaha, Nebr.	Gravel	....	140,000	$0.208	.....	.....	.....	.....	.....	.....	3	.35
Thurston	Dobson & Robinson, Lincoln, Nebr.	Gravel	....	148,600	$0.20½	.....	.....	.....	.....	.....	.....	2½	.35
Saline	Allied Const., Inc., Omaha, Nebr.	Gravel	....	13,700	.208	.....	.....	.....	.....	.....	.....	2½	.35
Saline	Allied Const., Inc., Omaha, Nebr.	Gravel	....	24,100	.232	.....	.....	.....	.....	.....	.....	1½	.35
Saline	Allied Const., Inc., Omaha, Nebr.	Gravel	....	62,500	.243	.....	.....	.....	.....	.....	.....	2½	.35
Cass	Yant Const. Co., Omaha, Nebr.	Gravel	....	10,520	.208	.....	.....	.....	.....	.....	.....	½	.35
Nemaha	Yant Const. Co., Omaha, Nebr.	Gravel	....	44,200	.21	.....	.....	.....	.....	.....	.....	2½	.35
Cass	Yant Const. Co., Omaha, Nebr.	Gravel	....	24,500	.214	.....	.....	.....	.....	.....	.....	1½	.35
Nuckolls	Koehler Lumber & Coal Co., Sterling, Nebr.	Gravel	....	123,200	.239	.....	.....	.....	.....	.....	.....	3	.35

* Rock excavation. † Structural steel. ‡ 1—3—6.

Weekly Construction Market

IMPORTANT price changes were absent from the market during the past week in the principal lumber producing areas and centers of distribution.

No definite direction is noticeable in price movements of any of the principal construction materials in the current market.

Linseed oil rose 5½c. in Atlanta, 3c. in Denver and San Francisco, and 1½c. at Minneapolis, during the week; declines of 1c. in Chicago and 1½c. per 7½ lb.-gal. at New York, were also reported.

There has been perceptible price firmness in several of the basic materials in the New York district during the last month. These include cement, lime, tile, yellow-pine flooring, steel scrap, composition shingles and plaster board. The market is a trifle softer in brick, plaster, white lead, crushed stone and 1-in. common boards. Few price changes occurred in steel products during the week. Scrap is measurably higher in the principal markets. Demand appears more active for semi-finished material, shapes, rails, nails, wire and pipe.

Black steel sheets rose 10c. and blue annealed declined 5c. per 100 lb. at Pittsburgh mills, comparing this week with last. Upward price movement in non-ferrous metals is reflected in higher quotations for fabricated brass and copper.

No let-up is apparent in the declining trend of manila rope quotations. Since July 1 the market has dropped 1c. in New York, and 2c. in Denver, Minneapolis and Chicago, while the price fell 3c. per lb. at San Francisco during the current week. Construction labor rates and conditions are about as they were a week ago.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, 100 lb	$3.34	$3.80	$4.15	$3.10	$3.35	$3.07½	$3.30	3.35	$4.00
Structural rivets, 100 lb	4.20	5.00	4.75	3.50	3.75	4.65	5.00	4.00	5.50
Reinforcing bars, ¾ in. up, 100 lb	3.24	+2.90	3.38	2.60	2.87½	3.77½	2.95	3.25	2.50
Steel pipe, black, 2½ to 6 in. lap, discount	48%	54%	53.6%	51%	54.25%	36%	35.6@49.2%	45%	37.83
Cast-iron pipe, 6 in. and over, ton	51.60@53.60	47.50	54.00	49.20@50.20	53.00	64.00	50.00	55.00	55.00
Concreting Material									
Cement without bags, bbl	2.50@2.60	2.35	2.05	2.10	2.32	2.85	2.31	2.65	1.15
Gravel, ¾ in., cu.yd	1.75	1.90	2.38	1.60	1.65	1.90	1.80	1.50	1.50
Sand, cu.yd	1.00	1.60	2.00	1.40	1.25	1.00	1.40	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.85	2.50	2.83	1.87½	1.75	2.50	1.70	3.00	2.00
Miscellaneous									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	62.00	34.00	56.00	40.50	38.25@38.50	34.75	27.00	23.00	55.00
Lime, finishing, hydrated, ton	18.20	23.50	20.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime, common, lump, per bbl	2.10@3.00	1.50	1.85	2.25	1.60@1.70	2.70	1.60	2.80	10.00
Common brick, delivered, 1,000	20.40@22.40	10.50	14.10	12.00	13.75	9@10	15.00	15.00	17.50
Hollow building tile, 4x12x12, per block	Not used	.0895	.112	.075	.076	.075	.....	09	—.10
Hollow partition tile 4x12x12, per block	.1112	.0895	.112	.075	.076	075	.108	09	—.08
Linseed oil, raw, 5 bbl. lots, gal	—.93	+1.01¼	1.13	—.94	+1.03½	+1.17	+1.00	1.12	1.03
Common Labor									
Common labor, union, hour	.90⅝	.30	.....	.87½	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	.....	.25	.30@.50	.82½	.45@.60	.40@.45	.50	.50	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent. L.c.l. is less than carload lots.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime in 280-lb. bbl. net and hydrated lime, f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Reinforcing bars (billet steel) and shapes delivered to job in less-than-carload lots.

Labor — Cement and concrete laborers' rate, $1.06½; building laborers, 90⅝c.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber, sand, gravel and stone f.o.b.; price on fir is quoted instead of pine. Reinforcing bars (billet steel) f.o.b. warehouse in carload lots; shapes, less-than-carload lots.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. Bars (billet steel) at warehouse in carload lots; shapes, less-than-carload lots.

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of Aug. 5 the next on Sept. 2.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered in wooden bbl. Common lump lime per 180-lb. net. Bars (billet steel) and shapes, l.c.l.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net. Bars (billet steel) and shapes, f.o.b. in carload lots.

Dallas quotes lime per 180-lb. bbl. Cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered. Bars (billet steel) and shapes, l.c.l.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C.-I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common. Bars (billet steel) f.o.b. in carload lots; shapes, l.c.l.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Brick and hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers. Bars (billet steel) and shapes, less-than-carload lots.

Montreal quotes on fir lumber. Sand, stone, gravel and lump lime per ton. Stone and tile are delivered; sand, gravel, lime and cement on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 100.14). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½ in., $37.83. Bars (billet steel) and shapes, less-than-carload lots.

Business Briefs

Call money quoted at 5 per cent, Aug. 10; year ago 4½ per cent.

Time loans: Sixty-ninety days, 4⅜@4½; four-six months, 4½@4⅝ per cent.

Commercial paper: Best names 4 per cent; other names, 4¼@4½ per cent.

On Aug. 1, 1926

E. N.-R. Construction Cost Index Number 208.30

E. N.-R. Construction Volume Index Number 248

For Explanation and Details of Indexes Since 1913 See the First Issue of Every Month